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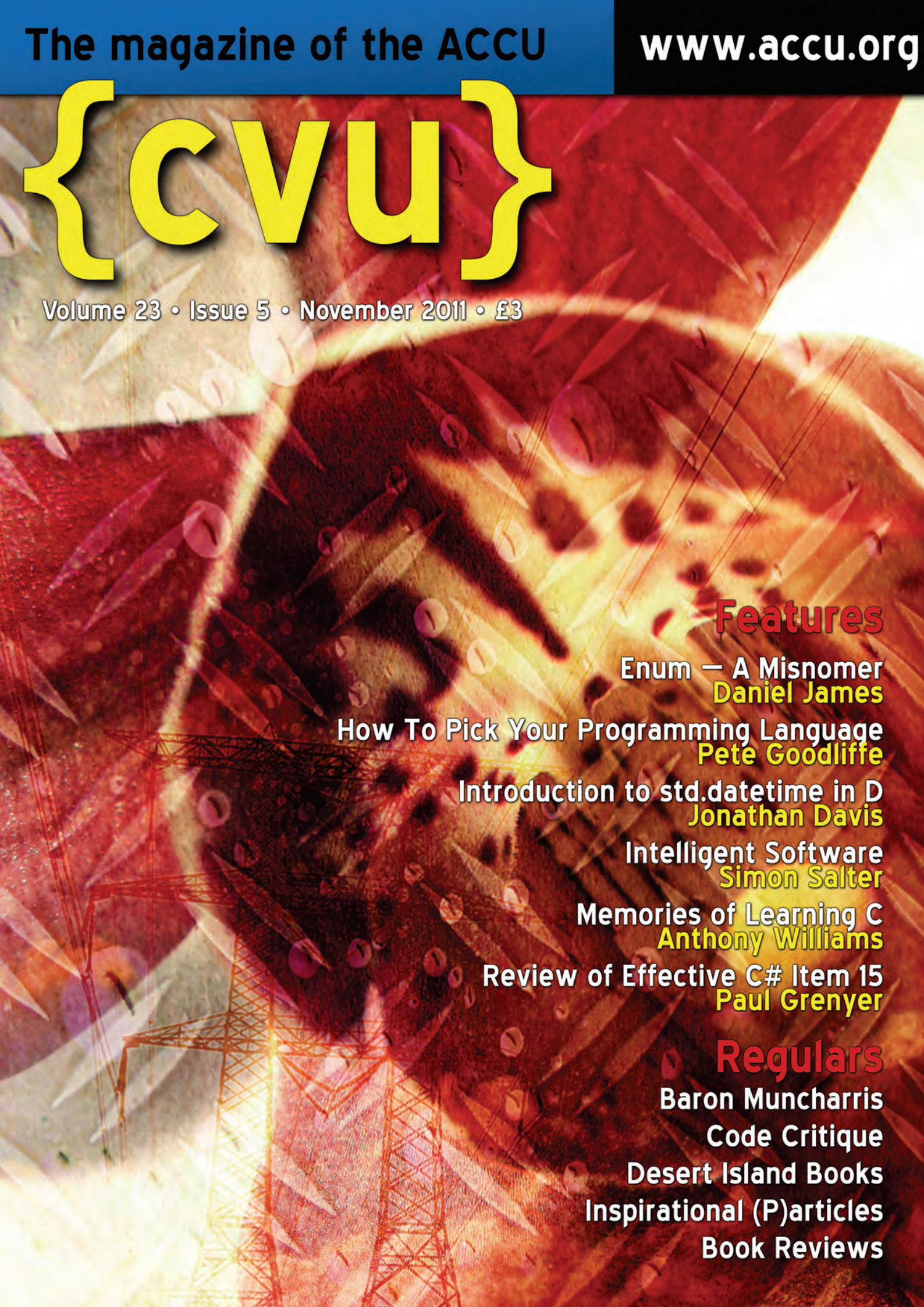

Features

Regulars

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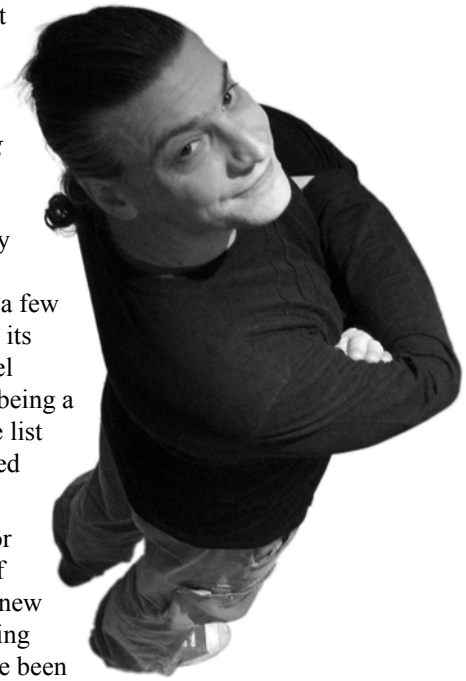
Language Barrier



I reckon I'm pretty safe in the assumption that most readers of this magazine already knew the name and reputation of Dennis Ritchie, who died in October 2011. He is probably best known as co-inventor of C and co-author of *The C Programming Language*, a text widely regarded as a pinnacle in technical authorship for its clarity and accessibility. One of the reasons that 'K&R' (as it's affectionately known by many) is so short is that its subject is, in concept, very simple; the C language imposes only a few reserved words on the programmer. And yet, for all its apparent simplicity, it is expressive enough to model hugely complex ideas – the Unix operating system being a prime example. ANSI C89 added 5 keywords to the list defined in 'K&R' C, to make 32 keywords, increased by another 5 for the 1999 standard.

This was brought to mind recently at a talk given for the ACCU London event by Jon Skeet. The topic of the talk (which was excellent, by the way!) was the new asynchronous programming features of the up-coming C# 5. These features look most interesting, and have been given a great deal of thought by the designers to make them easy to use correctly, and be able to express complex ideas as simply as possible. With one small wart – the new features introduce (at least) two new keywords to C# – a language that already requires the concept of 'Contextual Keywords' to manage its reserved list.

I recall Bjarne Stroustrup at the outset of the process which has recently resulted in C++11 being ratified by ISO, exhorting the committee to prefer new libraries instead of language features where feasible. C++11 has 83 keywords, an increase of 10 over C++98.

C# has 98 keywords as at version 4.0 (including contextual keywords), C# 5 will have *at least* 100.

I wonder if we will ever again see a language that can be entirely described in a book as truly succinct as K&R.

STEVE LOVE
FEATURES EDITOR

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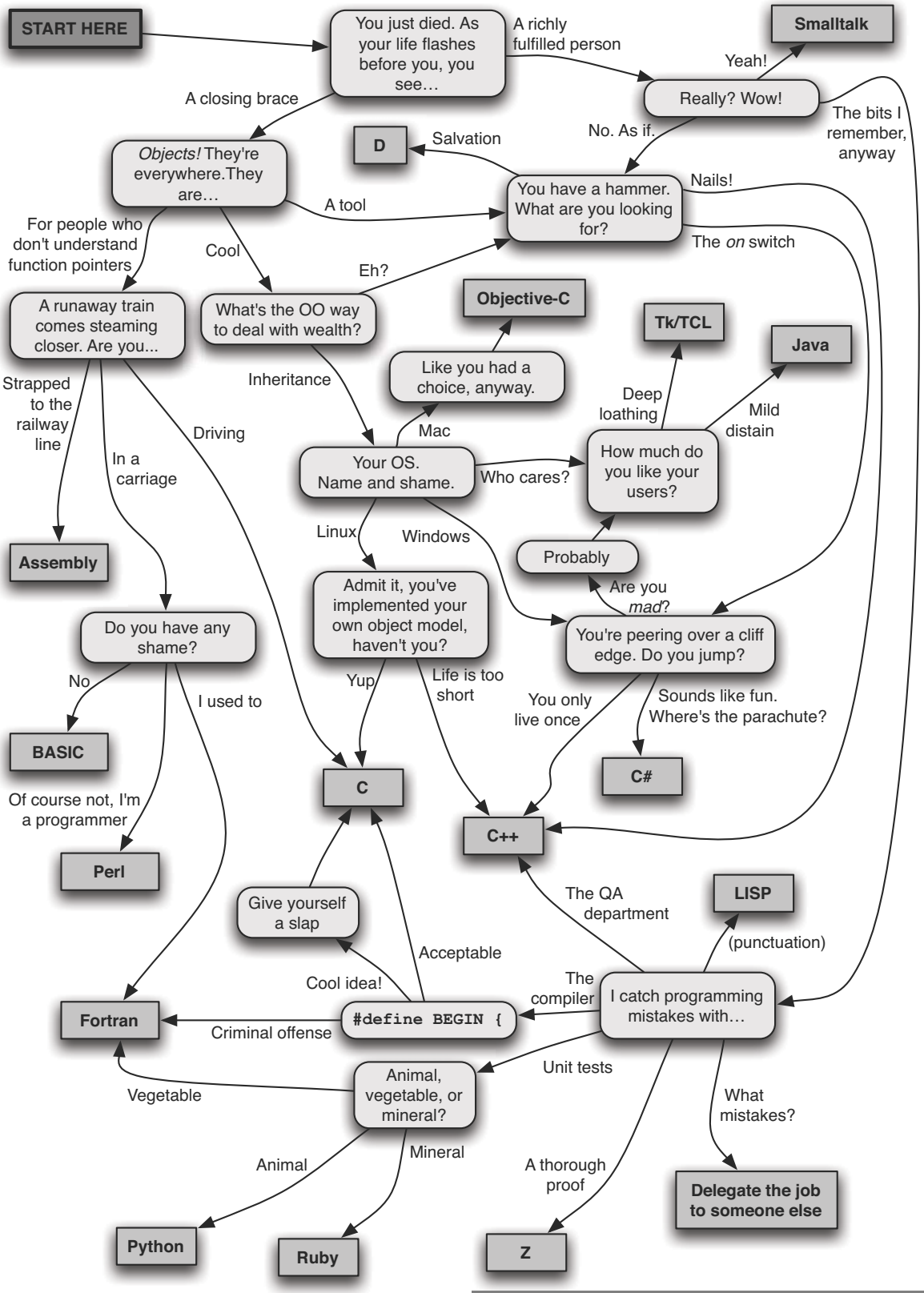

PETE GOODLIFFE

Pete Goodliffe is a programmer who never stays at the same place in the software food chain. He has a passion for curry and doesn't wear shoes. Pete can be contacted at pete@goodliffe.net

Introduction to std.datetime in D

Jonathan M Davis describes his contribution to Phobos, the D Standard Lib.

In dmd 2.052, the module **std.datetime** was introduced. It will be replacing **std.date** entirely. As such, **std.date** is currently scheduled for deprecation. At a later date it will be deprecated (at which point, you'll have to compile with **-d** for it to work rather than simply having the compiler complain when you use it), and eventually it will be fully removed from Phobos. What this means is that all new code should be written to use **std.datetime** and that any code which currently uses **std.date** is going to need to be refactored to use **std.datetime** (unless you want to copy **std.date** to your own code and continue to use it as a non-Phobos module). This article attempts to familiarize you with **std.datetime** as well as give some advice on how to migrate code from **std.date** to **std.datetime** for those who have been using **std.date**.

std.date is essentially a C-based solution for dates and times. It uses **d_time** to hold time where **d_time** is a 64-bit integral value holding the number of milliseconds which have passed since midnight, January 1st 1970 A.D. in UTC. C, on the other hand, uses **time_t** to hold time where **time_t** is an integral value holding the number of seconds which have passed since midnight, January 1st, 1970 A.D. in UTC. Its size varies from architecture to architecture (typically 32 bits on a 32-bit machine and 64 bits on a 64-bit machine, but it varies with the OS and compiler). The exact set of functions that **std.date** provides for using with **d_time** aren't the same as what C provides for using with **time_t**, but their representation of time is virtually the same.

std.datetime, on the other hand, is very much an object-oriented solution, and it's not C-based at all. Rather, its API is based on Boost's types for handling dates and times (though they're far from identical). So, it's a bit of a paradigm shift to move from **std.date** to **std.datetime**. Don't expect much to be the same between the two. However, **std.datetime** is not plagued with the same bugs that **std.date** is plagued with (**std.date** being quite buggy in general), and it provides much more functionality than **std.date** does. So, in the long run at least, dealing with **std.datetime** should be much more pleasant – though migration is likely to present a bit of a hurdle in the short term.

Basic Concepts of std.datetime

Most things in **std.datetime** are based on and/or use three concepts:

- **Duration**: A duration of time with units. e.g. 4 days or 72 seconds.
- **Time Point**: A specific point in time. e.g. 21:00 or May 7th, 2013.
- **Time Interval**: A fixed period of time. e.g. [02:44 – 12:22) or [February 4th, 1922 – January 17th, 1955).

Durations

The duration types can actually be found in **core.time**. They are **Duration** and **TickDuration**. **TickDuration** is intended for precision timing and is used primarily with **StopWatch** and the benchmarking functions found in **std.datetime** – such as benchmark – and you're unlikely to use it outside of using them. **Duration**, on the other hand, you're likely to use quite a bit.

```
auto duration = TimeOfDay(17, 2) - TimeOfDay(6,
7);
assert(duration ==
   dur!"hours"(10) + dur!"minutes"(55));
assert(duration.hours == 10);
assert(duration.minutes == 55);
assert(duration.total!"hours"() == 10);
assert(duration.total!"minutes"() == 655);
assert(duration.total!"hnsecs"() ==
   393_000_000_000);
```

Listing 1

Duration holds its time internally as hecto-nanoseconds (100 ns), so that's its maximum precision. It has property functions for both returning the duration of time truncated to a particular unit (such as the **days** and **seconds** property functions) as well as a function for returning the total number of a particular unit in that **Duration** (the **total** function).

Generally, a **Duration** is created in one of two ways: by subtracting two time points or with the **core.time.dur** function. So, for instance, if you subtracted a time point which represented 17:02 from a time point which represented 6:07, you'd get a **Duration** which represented 10 hours and 55 minutes. Or, if you wanted to create a **Duration** directly, then you'd use the **dur** function and make a call like **dur!"hours"(17)** or **dur!"seconds"(234)** (see Listing 1).

Like any number, **Duration**s can be added together or subtracted from. However, unlike a naked number, they have units associated with them and will handle the appropriate conversions. Also, it should be noted that the various functions in druntime and Phobos which take a duration of time take an actual **Duration** rather than a naked number (most currently take both, though the versions which take a naked number are going to be deprecated). For instance, **core.thread.sleep** takes a **Duration**, as does **std.concurrency.receiveTimeout**. So, durations are used outside of just interacting with **core.time** and **std.datetime**.

One particular thing to note here is how both **dur** and **total** take a string representing the units of time to be used. This is an idiom used throughout **core.time** and **std.datetime**. The possible units are **"years"**, **"months"**, **"weeks"**, **"days"**, **"hours"**, **"minutes"**, **"seconds"**, **"msecs"**, **"usecs"**, **"hnsecs"**, and **"nsecs"**. It should be noted however that very few functions take **"nsecs"**, because nothing in **std.datetime**, and very little in **core.time**, has precision greater than **hnsecs** (100 ns). Also, a number of functions (such as **core.time.dur**) do not take **"years"** or **"months"**, because it is not possible to convert between years or months and smaller units without a specific date. So, while you can add a **Duration** to a time point, if you want to add years or months to one, you must use a separate function (such as **add**) to do that – and those will take **"years"** and **"months"**.

Time Points

std.datetime has 4 types which represent time points.

- **Date**
- **TimeOfDay**
- **DateTime**
- **SysTime**

JONATHAN M DAVIS

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Listing 2

```
auto date = Date(1992, 12, 27);
auto tod = TimeOfDay(7, 0, 22);
auto dateTime = DateTime(1992, 12, 27, 7, 0, 22);
assert(date == dateTime.date);
assert(tod == dateTime.timeOfDay);
```

A **Date** represents a date and holds its year, month, and day as separate values internally. A **TimeOfDay** represents a time of day, 00:00:00 - 23:59:59, and holds its hour, minute, and second as separate values internally. A **DateTime** represents a date and time and holds its values as a **Date** and **TimeOfDay** internally. None of these types have any concept of time zone. They represent generic dates and/or times and are best-suited for cases where you need a date and/or time but don't care about time zone. Also, because they hold their values separated internally, those values don't have to be calculated every time that you ask for them. (See Listing 2.)

A **SysTime**, however, is an entirely different beast. It represents a date and time – similar to **DateTime** – but it goes to hnsec precision instead of only second precision, and it incorporates the concept of time zone. Its time is held internally as a 64-bit integral value which holds the number of hnsecs which have passed since midnight, January 1st, 1 A.D. in UTC. It also has a **TimeZone** object which it uses to polymorphically adjust its UTC value to the appropriate time zone when querying for values such as its year or hour.

SysTime is the type which is used to interface with the system's clock. When you ask for the current time, you get a **SysTime**. And because it always holds its internal value in UTC, it never has problems with DST or time zone changes. It has most of the functions that **DateTime** has as well as a number of functions specific to it. It can be cast to the other 3 time point types as well as be constructed from them, but you do risk problems with DST when creating a **SysTime** from the other 3 time points unless you specifically create the **SysTime** with a **TimeZone** which doesn't have DST (such as **std.datetime.UTC**), since when a time zone has DST, one hour of the year does not exist, and another exists twice. You can also convert to and from unix time, which is what you're dealing with in C with **time_t**.

The one other related type which I should mention at this point is **core.time.FracSec**. It holds fractional seconds, and it is what you get from a **Duration** or **SysTime** when you specifically ask for the fractional portion of the time. (Listing 3)

Time Intervals

std.date has nothing to correspond to time intervals, so I won't go over them in great detail. Essentially, they're constructed from either two time points or a time point and a duration. **Interval** is a finite time interval with two end points, whereas **PosInfInterval** is an infinite time interval starting at a specific time point and going to positive infinity, and **NegInfInterval** is an infinite time interval starting at negative infinity and going to a specific time point. They have various operations for dealing with intersections and the like. It is also possible to create ranges over them if you want to operate on a range of time points. Take a look at the documentation [1] for more details.

Listing 3

```
auto st1 = Clock.currTime();
//Current time in local time.

auto st2 = Clock.currTime(UTC());
//Current time in UTC.

auto st3 = SysTime(DateTime(1992, 12, 27, 7,
           0, 22), FracSec.from!"usecs"(5));
assert((cast(Date)st3) == Date(1992, 12, 27));
assert((cast(TimeOfDay)st3) ==
        TimeOfDay(7, 0, 22));
assert((cast(DateTime)st3) ==
        DateTime(1992, 12, 27, 7, 0, 22));
assert(st3.fracSec == FracSec.from!"hnsecs"(50));
```

Listing 4

```
time_t unixTime = core.stdc.time.time(null);
auto stdTime = unixTimeToStdTime(unixTime);
auto st = SysTime(stdTime);
assert(unixTime == st.toUnixTime());
assert(stdTime == st.stdTime);
```

Interfacing with C

Hopefully, you can do everything that you need to do using the types in **core.time** and **std.datetime**, but if you do need to interface with C code, then you can. C's **time_t** uses 'unix time' (seconds since midnight, January 1st, 1970 A.D. in UTC), whereas **SysTime** uses what it calls 'std time' (hnsecs since midnight January 1st, 1 A.D. in UTC). Translating between the two is fairly straightforward. To get a **time_t** from a **SysTime**, simply call **toUnixTime** on the **SysTime**. To convert the other way around, you first need to convert a **time_t** to std time, then pass that value to **SysTime**'s constructor. And if you ever simply need a **SysTime**'s std time for any reason, then use its **stdTime** property.

Hecto-nanoseconds were chosen as the internal representation of **Duration** and **SysTime**, because that is the highest precision that you can use with a 64-bit integer and still cover a reasonable amount of time (**SysTime** covers from around 29,000 B.C. to around 29,000 A.D.). It also happens to be the same internal representation that C# uses, so if you need to interface with C# for any reason, converting between its representation of time and **std.datetime**'s representation is extremely easy, since no conversion is necessary. C#'s **DateTime** uses both the same units and epoch for its internal representation (which it calls **Ticks**) as **SysTime**, though unlike **SysTime**, it doesn't work with negative values (which would be B.C.) and doesn't go past the end of 9,999 A.D. Most programs are unlikely to care about values outside that range however. Regardless, hnsecs make the most sense for **std.datetime**, which tries to have the highest precision that it reasonably can, so that's why they were picked.

Recommendations on Using std.datetime

Whether **Date**, **TimeOfDay**, **DateTime**, or **SysTime** is more appropriate in a particular situation depends very much on that situation. **Date**, **TimeOfDay**, and **DateTime** generally make the most sense when you're dealing with generic dates and times that have nothing to do with time zones, but if you're dealing with time zones at all or are dealing with anything which needs to worry about DST, you should use **SysTime**. Because it keeps its time internally in UTC, it avoids problems with DST. And while it does have a time zone component, it defaults to **std.datetime.LocalTime** (which is the time zone type for the local time of the system), so you don't generally have to deal directly with time zones if you don't want to.

If you do want to deal with time zones, then the time zone types in **std.datetime** are **LocalTime**, **UTC**, **SimpleTimeZone**, **PosixTimeZone**, and **WindowsTimeZone** – or if for some reason, they don't do what you need, you can always create your own time zone class derived from **TimeZone**. That's unlikely to be necessary, however (and if you think that you have come up with such a class which would be generally useful, please bring it up in the digitalmars.D newsgroup, since if it's truly generally useful, we may want some version of it in **std.datetime**). Read their documentation for more details. Most applications shouldn't have to worry about time zones though, beyond perhaps using **UTC** instead of **LocalTime** in some cases.

When it comes to saving a time point to disk or a database or something similar, I would generally recommend using the **toISOString** or **toISOExtString** functions, since both are standard ISO formats for date-time strings (**toISOExtString** is likely better in the general case, since it's more humanly readable, but they're both standard). You can then use **fromISOString** or **fromISOExtString** to recreate the appropriate time type later. **toString** uses the **toSimpleString**

Listing 5

```
auto dateTime = DateTime(1997, 5, 4, 12, 22, 3);
assert(dateTime.toISOString() ==
       "19970504T122203");
assert(dateTime.toISOExtString() ==
       "1997-05-04T12:22:03");
assert(dateTime.toSimpleString() ==
       "1997-May-04 12:22:03");
auto restored = DateTime.fromISOExtString(
       dateTime.toISOExtString());
assert(dateTime == restored);
```

function, which is an invention of Boost and is somewhat more humanly readable, but it isn't standard, so you probably shouldn't use it for saving time point values. (Listing 5)

One area with saving times as strings which gets a bit awkward is time zones. The time zone is included in the string as part of the ISO standard, but all it contains is the total offset from UTC at that particular date and time, so you can't generally use an ISO string (extended or otherwise) to get the exact time zone which the **SysTime** originally had. Rather, it will be restored with a **SimpleTimeZone** with the given offset from UTC (except in the case of UTC, where it can restore UTC). On the other hand, if you're using **LocalTime**, then the time zone is not part of the string (per the ISO standard), and restoring the **SysTime** will restore it to whatever the current time zone is on the box, regardless of what the original time zone was. However, because in all cases, except for **LocalTime**, the UTC offset is included in the string, it is generally possible to get the exact UTC time that the **SysTime** was for. But you can't usually restore the original time zone from just the ISO string. (Listing 6)

Listing 6

```
auto local = SysTime(629_983_705_230_000_035);
auto utc = local.toUTC();
auto other =
local.toOtherTZ(TimeZone.getTimeZone("America/
New_York"));

//This assumes that you're in "America/
Los_Angeles". You'd get a different
//time if you're in a different time zone.
assert(local.toISOExtString() == "1997-05-
04T12:22:03.0000035");

assert(utc.toISOExtString() == "1997-05-
04T19:22:03.0000035Z");
assert(other.toISOExtString() == "1997-05-
04T15:22:03.0000035-04:00");

auto restLocal =
SysTime.fromISOExtString(local.toISOExtString());
auto restUTC =
SysTime.fromISOExtString(utc.toISOExtString());
auto restOther =
SysTime.fromISOExtString(other.toISOExtString());

//Only guaranteed because it's on the same
machine.
assert(restLocal == local);

//Guaranteed regardless of machine. Their
internal values could differ however.
assert(cast(DateTime)restLocal ==
cast(DateTime)local);

//Time zone is UTC for both.
assert(restUTC == utc);

//Time zone for restOther is SimpleTimeZone(-4 *
60), not "America/New_York".
assert(restOther == other);
```

To summarize, **UTC** and **SimpleTimeZone** can be restored exactly using an ISO or ISO extended string. However, none of the other **TimeZone**s can be. **LocalTime** is restored with the same date and time but in the local time zone of the computer it's restored on, so its std time may differ. Other time zones end up with the restored **SysTime** having the same std time as the original, but the new time zone is a **SimpleTimeZone** with the same total UTC offset which the original time zone had at the given std time, but you don't get the original time zone back. That works just fine if you don't ever need to change the value of that **SysTime** or need to know the name of the original time zone, but it is inadequate if you need to do either of those, since the rules for the new time zone won't match those of the original.

So, if you don't care about the time zone or if the restored **SysTime** has the same std time as the original, then **LocalTime** is fine. However, if you want the std time to be consistent, then avoid **LocalTime**. In most cases, I'd advise simply using UTC as the time zone when saving the time. And if you want to restore the time zone such that it's the same time zone with the same rules as it was prior to saving the time, then you're going to need to save that information yourself. With a **PosixTimeZone** or a **WindowsTimeZone**, all you have to do is save the time zone's name (which for them is the TZ database name and the Windows time zone name of that time zone respectively). That can be used to restore the time zone. If it's a **SimpleTimeZone** or UTC, then you don't have to do anything, because the ISO string will be enough. If you're using **LocalTime**, however, you're in a bit of a bind.

The restored time zone will be **LocalTime**, so if you want it to be whatever the local time of the computer you're doing the restoring on is, then you're fine. But if you want to be able to have the same actual time zone restored regardless of the local time of the computer restoring the time, you'll need to figure out what the time zone's TZ database name or Windows time zone name is on the original computer so that you can use it to get its corresponding **PosixTimeZone** or **WindowsTimeZone** on the computer that's doing the restoring. But it's actually really hard to accurately determine the TZ database name or Windows time zone name of the local time zone on any OS other than on Windows, so **std.datetime** doesn't currently provide a way to do that. I expect that such a requirement would be quite rare however. In most cases, you'll care about **LocalTime** and/or UTC, and even if you're using **PosixTimeZone** or **WindowsTimeZone**, odds are that restoring the time with the correct std time value and correct UTC offset will be enough (and if it's not, you can always save the time zone's name to restore the correct **PosixTimeZone** or **WindowsTimeZone**). It's just **LocalTime** that has the problem. However, if a function to accurately determine the TZ database name of the local time zone on Posix systems is ever devised, then it will be added to **std.datetime**.

The other, more compact, option for saving a **SysTime** is to just save its **std** time as a 64-bit integer. It's not really humanly readable like an ISO or ISO extended string would be, but it takes up less space if saved as an actual number rather than a string. However, you do then have to worry about the time zone yourself entirely if you wish to be able to restore it. But if you save the current UTC offset (meaning the UTC offset with the DST offset applied – such as an ISO string would include), that would be enough to correctly give what the time would have been in the original time zone even if you can't restore that time zone.

Well, that's probably more than enough on time zones. In most cases, you shouldn't need to care about them (**SysTime** is designed to make it so that you shouldn't have to worry about them if you don't want to), but **std.datetime** strives to give the best tools possible for handling time zones when you actually want to. Regardless, by far the biggest gain that **SysTime** gives you is that its internal time is always in UTC, so regardless of whether you try and do anything with time zones explicitly, you won't have any problems with DST changes when dealing with **SysTime**.

One last suggestion on using **SysTime** would be that if you need to query it for more than one of its properties (e.g. day or hour), or if you need to do it many times in a row, and the **SysTime** isn't going to change, then you should probably cast it to another time point type (probably

Listing 7

```
auto st = Clock.currTime();

//Each value must be individually calculated.
{
  auto year = st.year;
  auto month = st.month;
  auto day = st.day;
  auto hour = st.hour;
  auto minute = st.minute;
  auto second = st.second;
    auto fracSec = st.fracSec;
  }

/+
  You do the calculations only twice if you
  convert to a DateTime (twice instead of once,
  because you're still asking for FracSec
  separately, though that particular calculation
  is fairly cheap).
+/
auto dateTime = cast(DateTime)st;
{
  auto year = dateTime.year;
  auto month = dateTime.month;
  auto day = dateTime.day;
  auto hour = dateTime.hour;
  auto minute = dateTime.minute;
  auto second = dateTime.second;
  auto fracSec = st.fracSec;
}
```

DateTime) and query it for those values. The reason for this is that every time that you call a property function on a **SysTime**, it has to convert its internal std time to the value of the property that you're asking for, whereas if you convert it to a **DateTime**, the **DateTime** holds those values separately, and you only have to do the calculations once – when you do the conversion from the **SysTime** to a **DateTime**. If what you're doing doesn't need that extra boost of efficiency, then you might as well not bother, but it is good to be aware that it's less efficient to query each of **SysTime**'s properties individually rather than converting it to a **DateTime** and then querying it.

Migrating to std.datetime

Okay, hopefully you have a fair idea of the basics of **std.datetime** at this point (though there's plenty more which is covered in the documentation), but the big question for many is how best to handle converting your code from using **std.date** to using **std.datetime**. When using **std.date**, you would have been using **d_time**, and if you had to worry about time zones, you were probably either using C functions to deal with conversions or just doing them yourself, since the functionality in **std.date** which relates to time zones is rather broken. As a result, most of what you would have done would likely be in UTC.

SysTime holds its time internally in UTC in a manner similar to **d_time** (albeit with different units and a different epoch), and it is the type intended for dealing with the time from the system's clock, so **SysTime** is generally what **d_time** should be replaced with. Functions in Phobos which previously took or returned a **d_time** now take or return a **SysTime** or are scheduled to be deprecated and have replacement functions which take or return a **SysTime**. Generally, in the case where a function took a **d_time**, that function is now overloaded with a version which takes a **SysTime**, but in cases where a function could not be overloaded (such as when it simply returned a **d_time**), a new function has been added to replace the old one (so as to avoid breaking existing code). The module that this impacts the most is **std.file**. For an example, see Listing 8.

Listing 8

```
d_time dTime = "myfile.txt".lastModified();
SysTime sysTime = "myfile.txt".timeLastModified();

setTimes("yourfile.txt", dTime, dTime + 5);
setTimes("yourfile.txt", sysTime,
         sysTime + dur!"msecs"(5));
```

With all such functions, it's simply a matter of changing the type of the argument that you're passing to the function or assigning its return value to and possibly changing the function name that you're calling so that it's the version that returns a **SysTime**. Those changes are quite straightforward and not particularly disruptive. Of greater concern are the formats that times are printed or saved in and how time zones are dealt with.

If you were saving the integral **d_time** value anywhere, then you're either going to have to switch to saving a value that **SysTime** would use as discussed previously (such as its std time or its ISO string), or you're going to have be converting between **d_time** and **SysTime**.

At present, the functions **std.datetime.sysTimeToDTime** and **std.datetime.dTimeToSysTime** will do those conversions for you. So, converting between the two formats is easy. However, because **d_time** is going away, those functions will be going away. That means that you either need to refactor your code so that those functions aren't necessary, or you need to copy them to your own code to continue to use them.

As for formatted strings, **std.datetime** currently only supports ISO strings, ISO extended strings, and Boost's simple string. Eventually, it should have functions for custom strings, but a well-designed function for creating custom strings based on format strings is not easy to design, and it hasn't been done for **std.datetime** yet (it's on my todo list, but it could be a while before I get to it). So, in general, you're either going to have to switch to using one of the string formats that **std.datetime** supports, or you're going to have to generate and parse the string format that you want yourself. In some cases, you should be able to adjust the string that **core.stdc.time.ctime** gives you, and in others, you may be able to use **toISOExtString** and adjust what it gives you, but there's a decent chance that you're going to have to just create and parse the strings yourself using the various properties on **SysTime**. One major difference between the string functions in **std.date** and those in **std.datetime** to note is that unlike **std.date**, aside from Boost's simple strings, nothing in **std.datetime** prints the names of months or weekdays, because that poses a localization issue. So, unless you're using **ctime** to get those values, you're going to have to create the names yourself.

Now, if you were doing anything with time zones with **std.date**, odds are that you were doing all of those conversions yourself (since that's one of the areas where **std.date** is buggy). That being the case, you probably have the offset from UTC and the offset adjustment for DST for whatever time zone you're dealing with. What is likely the best way to handle that is to create a **SimpleTimeZone** using those values. Simply calculate the total UTC offset (so add in the DST offset if it applies for the date in question) in minutes and create a **SimpleTimeZone** with that. Note that **std.datetime** treats west of UTC as negative (for some reason, some systems – particularly Posix stuff – use a positive offset from UTC when west of UTC, in spite of the fact that when talking about time zones, negative is always used for west of UTC, and that's what the ISO standard strings do). So, you may have to adjust your values accordingly. Regardless, be very careful to make sure that you understand what the

Listing 9

```
//These are the same offsets as
// America/Los_Angeles.
auto utcOffset = -8 * 60;
auto dstOffset = 60;

immutable tzWithDST =
   new SimpleTimeZone(utcOffset + dstOffset);
immutable tzWithoutDST =
   new SimpleTimeZone(utcOffset);
```

values you've been using represent in units of time and whether you need to be adding or subtracting them to convert them to what **SimpleTimeZone** expects for its offset from UTC: the minutes to add to the time in UTC to get the time in the target time zone. (Listing 9)

The last thing that I have to note is some differences in numerical values between **std.date** and **std.datetime**. **std.date.Date**'s **weekday** property gives Sunday a value of 1, but **std.date.weekDay** gives Sunday a value of 0. **std.datetime.DayOfWeek** gives Sunday a value of 0. So, depending on which part of **std.date** you're dealing with it, it may or may not match what **std.datetime** is doing for the numerical values of weekdays. Months have a similar problem. **std.date.Date**'s **month** property gives January a value of 1 – which matches what **std.datetime.Month** does – but **std.date.monthFromTime** gives January a value of 0. So, just as with the days of the week, you have to be careful with the numerical values of the months. Whether **std.datetime** matches what **std.date** is doing depends on which part of **std.date** you're using. And as you'll notice, it's not even consistent as to whether **std.date.Date** or the free function in **std.date** is the one which matches **std.datetime**. So, you should be very careful when converting code which uses numerical values for either the days of the week or the months of the year.

std.date symbols and their std.datetime counterparts

A table giving **std.date** symbols and their **std.datetime** counterparts can be found below.

std.date	std.datetime
std.date	**std.datetime** Equivalent
d_time	The closest would be **SysTime**
d_time_nan	There is no equivalent. **SysTime.init**, which has a null **TimeZone** object, would be the closest, but once CTFE (Compile-Time Function Execution [2] advances to the point that you can new up class objects with it, **SysTime.init**'s timezone will be LocalTime, so don't rely on **SysTime.init** being invalid. **std.datetime** in general tries to avoid having any invalid states for any of its types. It's intended that creating such values be impossible
Date	**SysTime**
Date.year	**SysTime.year**
Date.month	**SysTime.month**
Date.day	**SysTime.day**
Date.hour	**SysTime.hour**
Date.minute	**SysTime.minute**
Date.second	**SysTime.second**
Date.ms	**SysTime.fracSec.msecs**
Date.weekday	**SysTime.dayOfWeek** – but note that the values are off by 1.

Date.tzcorrection	`immutable tz = sysTime.timezone;`
	`auto diff = tz.utcToTZ(sysTime.stdTime) - sysTime.stdTime;`
	`auto tzcorrection = convert!("hnsecs", "minutes")(diff);`
	However, it looks like **tzcorrection** is broken, so you're probably not using it in your code anyway.

Date.parse	**SysTime.fromISOString**, **SysTime.fromISOExtString**, and **SysTime.fromSimpleString**, but the formats of the strings differ from what `std.date.Date.parse` accepts.
ticksPerSecond	There is no equivalent. It's only relevant to **d_time**.
toISO8601YearWeek	**SysTime.isoWeek**
hourFromTime	**SysTime.hour**
minFromTime	**SysTime.minute**
secFromTime	**SysTime.second**
daysInYear	**sysTime.isLeapYear ? 366 : 365**
dayFromYear	**(sysTime - SysTime(Date(1970, 1, 1), UTC())).total!"days"()**
yearFromTime	**SysTime.year**
inLeapYear	**SysTime.isLeapYear**
monthFromTime	**SysTime.month** – but note that the values are off by 1.
dateFromTime	**SysTime.day**
weekDay	**SysTime.dayOfWeek**
UTCtoLocalTime	**SysTime.toUTC**
dateFromNthWeekdayOfMonth	There is no equivalent. Listing 10 (below) is a possible implementation.
daysInMonth	**SysTime.endOfMonthDay;** Actually, this name is overly easy to confuse with **endOfMonth** – which returns a **SysTime** of the last day of the month. I will probably rename this to **daysInMonth**. But if I do, it won't be until the next release (2.054), and this name will be around until it's gone through the full deprecation cycle.
UTCtoString	There is no equivalent. You could probably parse and recombine **core.stdc.time.ctime** and **SysTime.toISOExtString** to create it though. However, this function appears to be fairly buggy in the first place, so odds are that your code isn't using it anyway.
toUTCString	There is no equivalent. You could probably parse and recombine **core.stdc.time.ctime** and **SysTime.toISOExtString** to create it though.

std.date	std.datetime
`toDateString`	There is no equivalent. You could probably parse and recombine `core.stdc.time.ctime` and `SysTime.toISOExtString` to create it though. However, this function appears to be fairly buggy in the first place, so odds are that your code isn't using it anyway.
`toTimeString`	There is no equivalent. You could probably parse and recombine `core.stdc.time.ctime` and `SysTime.toISOExtString` to create it though. However, this function appears to be fairly buggy in the first place, so odds are that your code isn't using it anyway.
`parse.parse`	`SysTime.fromISOString`, `SysTime.fromISOExtString`, and `SysTime.fromSimpleString`, but the formats of the strings differ from what `std.date.parse` accepts.
`getUTCtime`	`Clock.currTime(UTC())` if you want the `SysTime` to have its time zone be UTC. More likely though, you'll just use `Clock.currTime()`. Its internal time is in UTC regardless.
`DosFileTime`	`DosFileTime`
`toDtime`	`DosFileTimeToSysTime`
`toDosFileTime`	`SysTimeToDosFileTime`
`benchmark`	`benchmark`

Note that I'm not an expert on what does and doesn't work in `std.date`, so while I have noted some of the functions that I know to be broken, just because a function isn't labeled as broken in the above table does not mean that it works correctly. And any function which doesn't work correctly is obviously not going to give the same results as the `std.datetime` equivalent, since it's almost certain that the `std.datetime` version isn't buggy, let alone buggy in the same way (if it is buggy, the bug is almost certainly going to be far more subtle than any bug in `std.date`, since `std.datetime` is quite thoroughly unit tested).

Conclusion

Hopefully this article has improved your understanding of `std.datetime` and will get you well on your way to being able to migrate your code from `std.date` to `std.datetime`. If you have any further questions, please ask them on the digitalmars.D.learn newsgroup. And if there's a major use case of `std.date` which is not easy to convert over to `std.datetime` which I missed in this article and you think should be in it, please feel free to bring it up on the digitalmars.D newsgroup, and if need be, I'll update the online version of this article with the relevant information. ■

References

[1] http://www.d-programming-language.org/phobos/std_datetime.html
[2] http://d-programming-language.org/function.html

Listing 10

```
int dateFromNthWeekdayOfMonth(int year,
   Month month,DayOfWeek dow, int n)
{
  auto first = Date(year, month, 1);
  auto target = first;
  immutable targetDOTW = target.dayOfWeek;
  if(targetDOTW != dow)
  {
    if(targetDOTW < dow)
      target += dur!"days"(dow - targetDOTW);
    else
    {
      target += dur!"days"(
          (DayOfWeek.sat - targetDOTW) +
          dow + 1);
    }
  }
  target += dur!"weeks"(n - 1);
  if(target.month != first.month)
    target -= dur!"weeks"(1);
  return cast(int)(
     (target - first).total!"days"()) + 1;
}
```

A Game of Lucky Sevens

Baron Muncharris invites us to solve a new puzzle.

Greetings Sir R-----! This evening's chill wind might be forgiven some of its injurious assault upon me by delivering me some good company as I warm my bones. Come, shed your coat and join me in a glass of this rather delightful mulled cyder!

Might you be interested in a little sport whilst we recover?

Excellent!

This foul zephyr puts me in mind of the infantile conflict between King Oberon and Queen Titania that was in full force during my first visit to the faerie kingdom. I had arrived there quite by accident but fortunately my reputation was sufficient to earn me an invitation to dine at the King's table. That the fare was sumptuous beyond the dreams of mortal man goes without saying, but the conflict between the King and his consort cast something of a shadow upon the evening.

I resolved that I might ease the tension, and improve the terrible weather that was its consequence, by arranging some diversion that might afford the royal couple an opportunity to resolve their dispute. I therefore made my way back to the Earthly realm and employed a troupe of actors to put on a play for the faerie court. To my very great shame they revealed themselves to be utterly inadequate upon the night; the lead actor, one Nick Bottom, faring so badly that he made a comedy of Pyramus and Thisbe.

My reconciliatory efforts having been so thoroughly unsuccessful I retired to a faerie tavern and whiled my hours away at a game most popular in that realm.

But I must tell you of its rules!

Here I have a pair of fresh decks running from Ace to King, each suit in its turn. I shall set one deck unmolested before me and the other thoroughly shuffled before you. I shall then take my top card and, if it be a seven keep it for my hand, if not discard it. You shall then do likewise and we shall continue taking turns in such manner until one of us holds a trick of four sevens. If it is my good fortune to have it, you shall give me a bounty of eleven coins. If, on the other hand, you prevail, I shall give you nine.

When I described the game to that odious student whose company I am cursed to endure, he became somewhat agitated regarding the mention of that oafish Mr Bottom, perhaps unsurprisingly given his own oafish nature.

Listing 1

```
typedef std::vector<unsigned char> deck_type;

deck_type
deck()
{
  deck_type cards(52);
  for(size_t suit=0;suit!=4;++suit)
  {
    for(size_t face=0;face!=13;++face)
    {
      cards[suit*13+face] = face;
    }
  }
  return cards;
}
```

BARON MUNCHARRIS

In the service of the Russian military Baron Muncharris has travelled widely in this world, and many others for that matter, defending the honour and the interests of the Empress of Russia. He is renowned for his bravery, his scrupulous honesty and his fondness for a wager.

But let us not put a tarnish upon this night with talk of that feebleminded fellow; take another glass and consider your chances! ■

Listing 1 shows a C++ implementation of the game.

Listing 1 (cont'd)

```
void
play()
{
  const char names[13][10] = {"an Ace\0",
     "a Deuce\0",  "a three\0",  "a four\0",
     "a five\0",   "a six\0",    "a seven\0",
     "an eight\0", "a nine\0",   "a ten\0",
     "a Jack\0",   "a Queen\0",  "a King\0"};

  deck_type b_deck = deck();
  deck_type r_deck = deck();

  std::reverse(b_deck.begin(), b_deck.end());
  std::random_shuffle(r_deck.begin(),
                      r_deck.end());

  size_t b_hand = 0;
  size_t r_hand = 0;

  deck_type::const_iterator b_card =
     b_deck.begin();
  deck_type::const_iterator r_card =
     r_deck.begin();

  while(b_hand!=4 && r_hand!=4)
  {
    if(*b_card==6) ++b_hand;

    std::cout << "The Baron drew "
       << names[*b_card];
    std::cout << " and has a hand of " << b_hand
       << " seven";
    if(b_hand!=1)  std::cout << 's';
    if(*b_card==6) std::cout << '!';
    else           std::cout << '.';
    std::cout << std::endl;

    if(*r_card==6) ++r_hand;

    std::cout << "You drew " << names[*r_card];
    std::cout << " and have a hand of
       " << r_hand << " seven";
    if(r_hand!=1)  std::cout << 's';
    if(*r_card==6) std::cout << '!';
    else           std::cout << '.';
    std::cout << std::endl;

    ++b_card;
    ++r_card;
  }

  if(b_hand==4) std::cout << "The Baron wins!"
     << std::endl;
  else std::cout << "You win!" << std::endl;
}
```

On a Game of Path Finding

Our student analyses the Baron's last challenge.

You will recall that the Baron's latest game consists of seeking to build a path of counters across a board chalked out upon the tavern's hearth. The Baron was to place the first counter and strive to construct a path from the left to the right and Sir R----- was to follow and strive for one from top to bottom. They would continue to take turns in this fashion until a path had been forged, whereupon the victor would have a coin from the loser's purse. Figure 1 shows a path for the Baron.

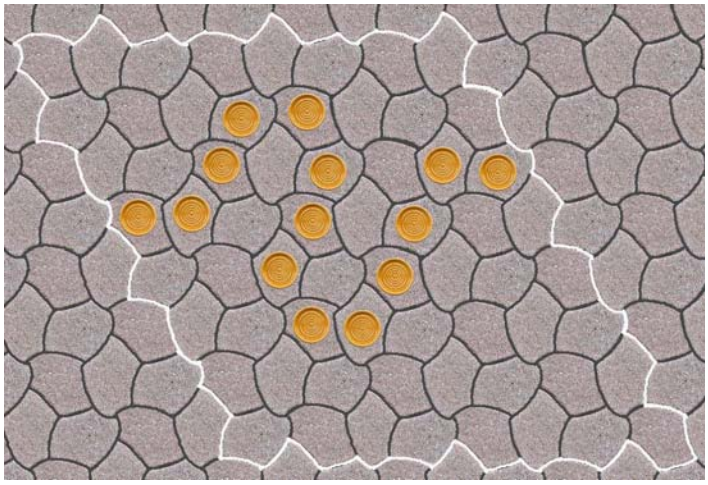

Figure 1

The first thing to note is that since each tile on the hearth is adjacent to six others, they are topologically identical to hexagons and the playing area is consequently equivalent to that of the board game Hex [1]. I said as much to the Baron, but I fear I may not have done so with sufficient clarity. The Hex board is shown in Figure 2.

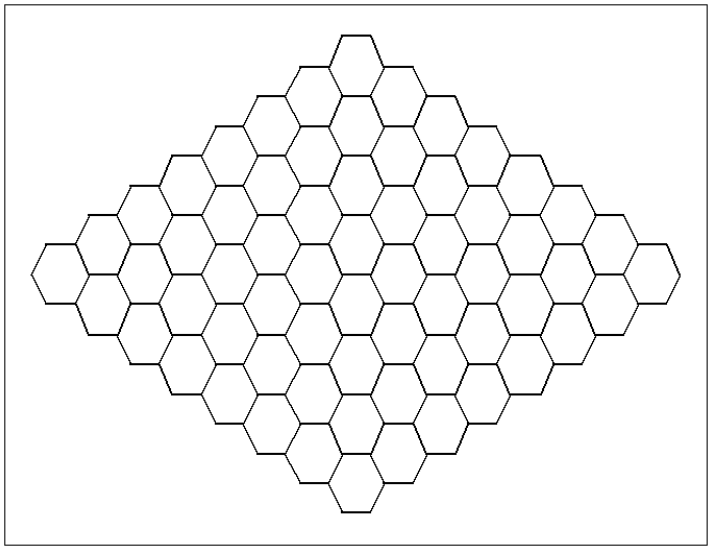

Figure 2

Now, this game cannot end in a draw since the only means by which either player can block all of the other's paths across the board is to make one of his own.

Noting this property, it was proven by one Mr Nash that the second player cannot force victory if the first player keeps his wits about him. He did so by first proposing that the second player had in mind a strategy that would ensure a win and then suggesting that the first player steal it. That is to say, he should place his first counter at random and thereafter use the second player's strategy, or again at random if that strategy demands he places a counter on his random spare. The first player could thusly steal the second's guaranteed win.

That mathematics abhors a contradiction is sufficient to demonstrate that the second player can have no such strategy, although it provides no hint as to how the first player might prevail.

I should therefore have advised Sir R----- not to take up the Baron's challenge, unless of course, he believed he had the wits to overcome this disadvantage.

An interesting consequence of Mr Nash's proof is that for any symmetric game in which the first player may elect to pass it is impossible for the second to guarantee success. ■

References

[1] Gardner, Martin (1959). *Hexaflexagons and other Mathematical Diversions – The First Scientific American Book of Puzzles and Games*. Simon and Schuster.

Review of Effective C# Item 15: Utilize using and try-finally for Resource Clean-up

Paul Grenyer gets to grips with the Dispose pattern.

The original *Effective C++* series from Scott Meyers was a real revelation for C++ programmers. It grouped together many idioms from the wildly diverse and complex language and made them understandable. It identified many of the pitfalls and made them avoidable. It was a must read for every serious C++ programmer.

Since then all the major language seems to have an effective series. You would think this was a good idea, but most languages are not as wildly complex as C++, with fewer idioms and pitfalls. They're still there, but the languages have been designed with the idioms in mind, and the introductory texts teach them, and with a lot of the pitfalls already avoided. Consequently most effective series for modern languages are smaller and contain a lot of patterns as well. For example, *Effective Java* starts off with the builder pattern. To my mind that belongs in a patterns book and it certainly should not be the first Java idiom described.

I am currently reading *Effective C#* by Bill Wagner. I've got as far as chapter 18 and so far it is full of good advice, but, in my opinion, is extremely poorly explained. Items 6 and 7 cover equality and `GetHashCode`. These are complex concepts in predominantly reference based languages, like C#, and after I'd finished reading the items I didn't feel I understood them much better.

Items 12 to 20 cover resource management. This is a real passion of mine, so naturally I'm quite critical of what's written here, as well as how it's actually written. Luckily most of what's written is sound, but part of Item 15 gives, in my opinion, some just plain bad advice. The following item,16, is another exceptionally badly written item, all though the advice is sound, but I'll leave that for another time.

Item 15: Utilize using and try-finally for Resource Clean-up

Resource management is probably the biggest Achilles heal of garbage collected languages. As such, it should probably be the subject of the first section of any effective series, but item 15 out of 50 isn't too bad.

How and why resources need to be managed in C# is explained satisfactorily by the item, so I won't go over it again. However I was highly amused by one paragraph: 'Luckily for you, the C# language designers knew that explicitly releasing resources would be a common task. They added keywords to the language to make it easy.' Surely this is treating a symptom, not solving the problem and they should have found a way to encapsulate resource management within types.

My real issue with this item is what the author describes as an ugly construct. There is an example of `using` with both a `SqlConnection` and a `SqlCommand` (see Listing 1).

Alternatively, as Steve Love pointed out to me, it could be written as in Listing 2, but I feel this does not express the scope of the open connection as clearly.

The author points out that you've effectively written the construct in Listing 3.

Listing 1

```
public void ExecuteCommand(string connString,
                           string commandString)
{
  using (var myConnection =
   new SqlConnection(connString))
  {
    using(var myCommand  =
     new SqlCommand(commandString, myConnection))
    {
      myConnection.Open();
      myCommand.ExecuteNonQuery();
    }
  }
}
```

Listing 2

```
public void ExecuteCommand(string connString,
                           string commandString)
{
  using (var myConnection =
     new SqlConnection(connString))
  using(var myCommand  =
     new SqlCommand(commandString, myConnection))
  {
    myConnection.Open();
    myCommand.ExecuteNonQuery();
  }
}
```

Listing 3

```
public void ExecuteCommand(string connString,
                           string commandString)
{
  SqlConnection myConnection = null;
  SqlCommand myCommand = null;
  try
  {
    myConnection = new SqlConnection(connString);
    try
    {
       myCommand = new SqlCommand(commandString,
                                  myConnection);
       myConnection.Open();
       myCommand.ExecuteNonQuery();
    }
    finally
    {
      if (myCommand != null)
          myCommand.Dispose();
    }
  }
  finally
  {
    if (myConnection != null)
        myConnection.Dispose();
  }
}
```

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Listing 4

```
public void ExecuteCommand(string connString,
                           string commandString)
{
  SqlConnection myConnection = null;
  SqlCommand myCommand = null;
  try
  {
    myConnection = new SqlConnection(connString);
    myCommand = new SqlCommand(commandString,
                               myConnection);
    myConnection.Open();
    myCommand.ExecuteNonQuery();
  }
  finally
  {
    if (myConnection != null)
        myConnection.Dispose();
    if (myCommand != null)
        myCommand.Dispose();
  }
}
```

As he finds it ugly, when allocating multiple objects that implement **`IDispose`**, he prefers to write his own **`try`**/**`finally`** blocks (Listing 4).

I have two problems with this. The first is that if the FINALLY FOR EACH RELEASE pattern, as described by Kevlin Henney in *Another Tale of Two Patterns* [1], is correctly implemented, the null checks, which are a terrible code smell and often the cause of bugs if they get forgotten, would be completely unnecessary (see Listing 5).

If the nested **`try`** blocks are a problem for you, another method can be introduced, shown in Listing 6.

However, the real problem is that you are only effectively implementing this construct. If you stick with the original nested using blocks, the compiler creates the construct for you and you don't see it. Which means that it really doesn't matter how ugly it might be and ditching the using blocks and writing your own construct just creates the ugliness. Maybe the root of the author's aesthetic objection is the nesting. Again, this is easily overcome by introducing another function, shown in Listing 7.

Listing 5

```
public void ExecuteCommand(string connString,
                           string commandString)
{
  var myConnection =
     new SqlConnection(connString);
  try
  {
    var myCommand = new SqlCommand(commandString,
                                   myConnection);
    try
    {
      myConnection.Open();
      myCommand.ExecuteNonQuery();
    }
    finally
    {
      myCommand.Dispose();
    }
  }
  finally
  {
    myConnection.Dispose();
  }
}
```

Listing 6

```
public void ExecuteCommand(string connString,
                           string commandString)
{
  var myConnection = newqlConnection(connString);
  try
  {
    ExecuteCommand(myConnection, commandString);
  }
  finally
  {
    myConnection.Dispose();
  }
}
private void ExecuteCommand(
   SqlConnection myConnection,
   string commandString)
{
  var myCommand = new SqlCommand(commandString,
                                 myConnection);
  try
  {
    myConnection.Open();
    myCommand.ExecuteNonQuery();
  }
  finally
  {
    myCommand.Dispose();
  }
}
```

Finally

In conclusion, the final part of the summary advice given in the chapter which states, 'Whenever you allocate one disposable object in a method, the using statement is the best way to ensure that the resources you allocate are freed in all cases. When you allocate multiple objects in the same method, create multiple using blocks or write your own single **`try`**/**`finally`** block.' should be ignored in favour of '... When you allocate multiple objects in the same method, create multiple using blocks.' ■

References

[1]'Another Tale of Two Patterns': http://www.two-sdg.demon.co.uk/curbralan/papers/AnotherTaleOfTwoPatterns.pdf

Listing 7

```
public void ExecuteCommand(string connString,
                           string commandString)
{
  using (var myConnection =
     new SqlConnection(connString))
  {
    ExecuteCommand(myConnection, commandString);
  }
}
private void ExecuteCommand(
   SqlConnection myConnection,
   string commandString)
{
  using (var myCommand =
     new SqlCommand(commandString, myConnection))
  {
    myConnection.Open();
    myCommand.ExecuteNonQuery();
  }
}
```

Enum – a Misnomer

Daniel James exposes enum as unsuitable for enumeration.

I read Matthew Wilson's recent article on enums in C and C++ [1] with some interest. Wilson gives a good overview of the capabilities of **enum** types in these languages and some helpful tips on their use, especially on their use as enumerations.

As I read, though, I found myself asking why such an article was necessary at all. Isn't an **enum** just about as simple as any datatype you can have … apart maybe from **int**? Shouldn't all of this be obvious? Clearly it isn't obvious – or there would be no need for such an article – and I would suggest that the reason we need do articles like this is that **the C++ enum type is not an enumeration type**. That's quite a claim: The C++ standard uses the word enumeration to describe an **enum** type – so why do I say that it isn't one?

My dictionary [2] says that the verb 'enumerate' is connected with census taking, and means to 'specify as in a list (a number of things) one by one' or to 'ascertain the number of', and that 'enumeration' means 'The action of enumerating' or 'A list, a catalogue'. The concept embodied in this definition is that of a fixed set of entities with distinct values that can be examined in turn.

In programming, the notion of an enumerated type in programming was first introduced by Niklaus Wirth in the Pascal programming language [3]. Enumerated types in Pascal have very similar semantics to subranges of integral types (which Pascal also supports) with the additional feature of defining a named constant for each value in the range. Pascal's **enum**s therefore implicitly represent ordered sequences of consecutive integer values. Pascal's **enum**s are never implicitly converted to or from integer types, but Pascal provides a full set of comparison operations between **enum** values and the **PRED** and **SUCC** functions which return the predecessor and successor values within the type, to enable iteration over the set of values. There are also **ORD** and **VAL** functions which are effectively casts to convert between enumeration values and their ordinal positions within the type. Listing 1 shows a Pascal **enum** definition for the same Fruit type as in Wilson's C++ example.

I'd say that Pascal's **enum** is pretty-much what a programmer with no preconceptions would expect an 'enumeration' to be, based on the dictionary definition. There is no way to ask Pascal for the number of values in the type, nor any way to ask for the minimum or the maximum value, but it is the nature of Pascal that you generally have to know these things to be able to use the type at all. Listing 2 shows a typical snippet of Pascal code that defines an **enum** representing days of the week, a subrange of that **enum** representing weekdays, and an array of integers that can be subscripted by weekday values. Listing 3 shows a procedure that initializes a value of the array type. Note that the original Pascal is so strongly typed that only an array of that exact type can be passed, so having to hard-code Monday to Friday is not as limiting as it seems (though it could be a maintenance headache if the number of days in a week were to change). More modern Pascal dialects – especially those based on Borland's Object Pascal (aka the Delphi language) – offer much richer functionality.

Pascal's definition of enumerated types was the first, and it was refined and extended in the other 'Wirth' languages that followed on from Pascal, and further still in Ada. All these languages add features, but the essential design of an enumerated type as an ordered set of named integer values is unchanged. Modula-2 [4] adds functionality to determine the highest and lowest enumerators of a type, so code can be more robust in the face of possible changes to the definition of the enum type. Listing 4 shows a trivial example using the new syntax, which will continue to work correctly even if new fruit types are added to the **enum**. Modula-2 also adds new **INC** and **DEC** operators, as shortcuts which modify a variable or an **enum** type (or any other scalar type) in situ in very much the same way as **operator++** and **operator--** do in C++, and are useful in writing loops other than the simple **FOR** to loop over all the values of a type.

Ada provides similar functionality, but in a slightly different way. In Ada the maximum and minimum values of an enumeration are given by the **'first** and **'last** attributes of the type, and values have **'succ** and **'pred** attributes that provide access to their successor and predecessor

Listing 1

```
type fruit =
(
   apple, (* Implicitly given value zero *)
   banana,
   orange
);
```

Listing 2

```
(* Day is an enumeration of all days, implicitly
0..6 *)
Type Day = ( Sunday, Monday, Tuesday, Wednesday,
Thursday, Friday, Saturday );
(* Weekday is a subrange of day, 1..5 *)
Type WeekDay = Monday..Friday;
(* WeekDayCount is a 1..5 array *)
Type WeekDayCount = ARRAY [WeekDay] of integer;
```

Listing 3

```
(* This procedure sets all elements of a
WeekDayCount array to zero *)
Procedure ClearWeekdayCount( x : WeekDayCount );
  Var index : WeekDay;
Begin
  (* Here we have to know that the bounds of
     WeekDayCount are Monday..Friday *)
  For index := Monday to Friday do
    x[index] := 0;
End;
```

Listing 4

```
MODULE etest;
FROM StrIO IMPORT WriteLn, WriteString;
FROM NumberIO IMPORT WriteCard;
TYPE Fruit = ( apple, orange, banana );
VAR f : Fruit;
BEGIN
   (* Because the language knows the range of
      values in the type this code will not need
      to be changed if new values are added
      to the definition of Fruit *)
   FOR f := MIN(Fruit) TO MAX(Fruit) DO
      WriteString( "Fruit value is " );
      WriteCard( ORD(f), 0 );
      WriteLn;
   END;
END etest.
```

DANIEL JAMES

Daniel James owns Sonadata Limited, a one-man software consultancy based in Maidenhead. He has been learning programming languages for over 30 years, and has yet to find an entirely satisfying one so continues to use C++ for most of his work.

Listing 5

```
-- Enumeration types in Ada
with Ada.Text_IO;
with Ada.Integer_Text_IO;
procedure test_enum is
  type Fruit is ( Apple, Orange, Banana  );
  package Fruit_IO is
     new Ada.Text_IO.Enumeration_IO( Fruit );
begin
  for f in Fruit'First..Fruit'Last loop
    Ada.Text_IO.Put( "This fruit is a " );
    Fruit_IO.Put( f );
    Ada.Text_IO.Put( " with ordinal value " );
    Ada.Integer_Text_IO.Put( Fruit'Pos( f ) );
    Ada.Text_IO.New_Line;
  end loop;
end test_enum;
```

Listing 6

```
-- Enumeration types in Ada
with Ada.Text_IO;
with Ada.Integer_Text_IO;
procedure test_enum is
  type Command is ( On, Off, Slow, Fast );
  -- This is a representation clause that sets
  -- the values that will be held in memory for
  -- each of the enumerators
  for Command use ( On=>16#20#, Off=>16#21#,
                    Slow=>16#40#, Fast=>16#41# );
  package Command_IO is
     new Ada.Text_IO.Enumeration_IO( Command );
begin
  for f in Command'First..Command'Last loop
    Ada.Text_IO.Put( "Command " );
    Command_IO.Put( f, Command'width );
    Ada.Text_IO.Put( " has position " );
    Ada.Integer_Text_IO.Put( Command'Pos( f ),
       0 );
    Ada.Text_IO.New_Line;
  end loop;
end test_enum;
```

Listing 7

```
Command ON   has position 0
Command OFF  has position 1
Command SLOW has position 2
Command FAST has position 3
```

values, and an **'image** attribute to obtain their string representation. The string representation is taken from the enumerator name in the sourcecode (converted to upper case, as Ada sourcecode is case insensitive), and is only really useful for logging and debugging, because it makes no allowance for internationalization.

Listing 5 shows a simple Ada example based around the familiar Fruit type that prints out the names of the fruits and their ordinal positions in the type. To print the names I've used the generic Ada package **Ada.Text_IO.Enumeration_IO** which in turn uses the **'image** attribute mentioned above. Note the use of the **'width** attribute of the type, which gives the length of the longest **'image** attribute that can be returned by the type, for aligning output. (Note also that it's only useful if you're using a fixed-pitch font!)

In Pascal and Modula-2 there's no great magic going on, nor much runtime calculation to cause overheads. The languages are strongly enough typed that the actual type of any **enum** variable is known at compile time and the **MAX** and **MIN** 'functions' in Modula-2 are compile-time constants, while things like the **SUCC** and **PRED** functions are simply increments and decrements (perhaps with a range check, depending on the implementation and debug level). Converting an **enum** value to its enumerator name requires a lookup into a table of enumerator name strings, so that table does represent a space overhead in implementations that offer it.

In Ada there is an added complication that the programmer can use a representation clause to specify the actual bit pattern stored in memory for a given **enum** value (e.g. for access to memory-mapped hardware ports). This looks a bit C-like, but really it isn't – the bit patterns are almost entirely invisible to the program once they have been set up. Listing 6 shows a variation of the program from Listing 5 that enumerates the items in a hypothetical **Command** type whose underlying values might be command bytes to be sent to a motor controller, where a byte with bit 5 set controls the on/off state of the motor and a byte with bit 6 set controls the motor speed, and in each case the value of bit 0 indicates on or off. Although the values used for storage have been changed the program still behaves as if the **enum** had values 0..3, and the only way to access the actual stored bit pattern is by aliasing it with another type.

Listing 7 shows the result of running this program. Note that although we've set the hardware values corresponding to the different enumerators to non-contiguous values it is still possible to enumerate all the values in software, and their positions are still reported as 0..3. Clearly there must be some overhead in implementing the **'pred** and **'succ** attributes in this case, as they no longer represent a simple increment or decrement of the internal **enum** value.

So how does all this relate to the **enum** type in C and C++?

I don't know when the concept of enumerated types was first implemented in C. They do not appear in the first edition of K&R [5] but are described in the second edition [6] ten years later, with a note that they had been implemented by some vendors some years previously. C's implementation of **enum**s differs quite noticeably from that of the Wirth languages in two ways:

- The values of the enumerators can be assigned by the programmer, and are not constrained to be ordered or consecutive
- There is no mechanism for looping over all the legal values (and only the legal values) of the type.

The first difference makes the C **enum** more than an enumerated type, the second makes it less than one.

To a large extent the second difference is a consequence of the first: if the values are not ordered and sequential it's not trivial to loop over them. C could have been designed to support the same sort of enumeration mechanism that we have seen with Ada enums that have representation clauses – but that would be an uncharacteristically high-level construct for C, and would require some runtime overhead, so the language doesn't support it.

The C **enum** can be used for enumeration so long as the enumerator values are selected so as to be consecutive, and as C **enum** variables are simply integers they can be incremented and decremented using the same arithmetic operations as any other integers. Listing 8 shows a simple C program that illustrates that an **enum** can be used for enumeration in C about as easily as in Pascal as long as the requirement for the enumerators to be consecutive is observed.

Stroustrup says [7] that when designing C++ he had no particular desire to include an enumeration type beyond the need for compatibility with C, so the C++ **enum** was basically the same as the C one, but with added type safety. Type safety is good – Pascal has type safety between **enum**s and other types – but making the **enum** type distinct from integer types makes integer operations, in particular increment and decrement, unavailable to **enum**s. The simple solution is to cast between **enum** and **int**, as seen in Listing 9 which is the the C++ version of the C program from Listing 8. Note that this simple example was written to show the awkwardness of the cast so I have not included any of the refinements that Wilson advocates, such as **Unknown_Fruit** and **Maximum_Fruit_Value** members in the **enum**.

Of course, it's possible to define an operation that wraps up the increment operator for an **enum** type in a clean and typesafe way, we can even use a template to do it for all **enum** types. If we're using the new C++11 scoped

Listing 8

```
/* tenum.c */
#include <stdio.h>
enum Fruit { apple, orange, banana };
int main( int argc, char** argv )
{
  enum Fruit f;
  /* enum Fruit is just an integer, so we can
     increment it */
  for( f=apple; f<=banana; ++f )
  {
    printf( "This is fruit %d\n", f );
  }
  return 0;
}
```

Listing 9

```
// C++ Enumeration example
#include <iostream>
// If we're to enumerate the fruit they must have
// consecutive values
enum Fruit { apple, orange, banana };
int main( int argc, char** argv )
{
  enum Fruit f;
  // We can enumerate the fruit with a cast
  for( f=apple; f<=banana;
       f = static_cast<Fruit>(f+1) )
  {
    std::cout << "This is fruit "
              << f << std::endl;
  }
  return 0;
}
```

Listing 10

```
// tscopedenum.cpp
#include <boost/utility.hpp>
#include <boost/type_traits.hpp>
#include <iostream>
// Our Fruit enum. The convention is
// - the first enumerator is Unknown with value 0
// - all valid values follow with consecutive
//   values
// - the last enumerator is MaxValue
enum class Fruit
{
  Unknown=0,
  apple,
  orange,
  banana,
  MaxValue
};
// A different enum to show the scoping works
enum class Vegetable
{
  Unknown=0,
  carrot,
  parsnip,
  pea,
  sprout,
  MaxValue
};
```

enums we can also write generic code to enumerate over the values of any **enum** type that has been written to support enumeration as Listing 10 shows. Note that without scoped **enum**s we could not have the same **MaxValue** enumerator name in more than one **enum** type, and there would be no generic way to write the **end()** function).

Listing 10 (cont'd)

```
// A template for operator++ for all enum types
// (only)
template <typename T>
typename boost::enable_if< boost::is_enum<T>,
   T>::type
operator++( T & t )
{
  return t = static_cast<T>(
     static_cast<int>(t)+1 );
}
// A template function end() to return the
// MaxValue for any enum
template <typename T>
typename boost::enable_if< boost::is_enum<T>,
    T>::type
end()
{
  return static_cast<T>( T::MaxValue );
}
// A template function begin() to return the
// first value for any enum
template <typename T>
typename boost::enable_if< boost::is_enum<T>,
   T>::type
begin()
{
  return static_cast<T>( 1 );
}
int main( int argc, char** argv )
{
  for( auto f=begin<Fruit>();
            f!=end<Fruit>(); ++f )
  {
    std::cout << "This is fruit " <<
       static_cast<int>(f) << std::endl;
  }
  for( auto f=begin<Vegetable>();
     f!=end<Vegetable>(); ++f )
  {
    std::cout << "This is veggie " <<
       static_cast<int>(f) << std::endl;
  }
  return 0;
}
```

Scoped **enum**s can be made to offer just about all the functionality that one might expect from a real enumeration type, but only as long as one follows the conventions that Wilson describes and is prepared to write a little code. There is no generic way to get the enumerator names as strings as Ada does – that would require language support that C++ just doesn't offer – but I don't see that as necessary functionality for an enumerated type, as one would normally want more functionality than the compiler-generated names would offer (internationalization, different forms of name for singular and plural (one cherry but two cherries), etc.).

I started by saying that the C++ **enum** was both less and more than an enumerated type. So far I've talked about the less, but I should say a few words about the more as well. Because a C or C++ **enum** isn't constrained to contain a sequence of values starting from zero, as is a Pascal **enum**, it can be used to define and name any group of compile-time constants. Because an **enum** is a proper type, unlike a preprocessor symbol, it follows the language scoping rules and its visibility can be limited to a given **struct** or function (in C) or class or namespace (in C++) – these benefits are well known. These things are also true of **const int** values, of course, but the grouping of related names constants into an **enum** serves to document the relationship between them and aids code readability. Also, older compilers don't allow initialization of **const int** values within class definitions, so it may (still) be necessary to use **enum** values to define compile-time constants within the class.

Intelligent Software Design

Simon Salter receives divine inspiration for a satirical view of the design process.

This was revealed to me the other morning. I was walking the dog and found myself luminescent in a beam of sunlight which penetrated the stormy clouds and infused my inner being with a deep, wise and irrefutably true revelation concerning software architecture. A new paradigm for creating absolutely correct and inimitable software.

Intelligent software design is the one true path for the righteous programmer.

Project managers struggling with devilish delivery schedules will be blessed in the divine knowledge that intelligent software design is guaranteed to take only six days to create everything. On the seventh day you can have a rest and contemplate your creation.

Unlike some blasphemous design methodologies objects are not mutable in any way. They cannot evolve and iteration is a heresy. Objects always appear fully formed and absolutely correct. They may later get corrupted by memory overwrites, also known as the greed of man, but this can be avoided by using the dogmatic interface.

There is only one true singleton which is of irreducible complexity. You may attempt to make others (the idol pattern) but your program will crash, the computer will burn and there may be a faint smell of sulphur.

Praying during acceptance testing is not only allowed but actively encouraged. The debugging prayer is particularly easy to learn and always works. Guaranteed. Never fails.

Asynchronous messages may originate from any sufficiently old object and these can always be interpreted in a way that is convenient.

Counting is done two by two, a technique which can handle all things bright and beautiful up to numbers of truly biblical proportions.

The useful disciple logic function supports arbitrary repeat counts. You can call this as many times as needed to ensure that it must be true.

Expressions which use a canonical form are prefixed with St.

Objects which consist entirely of pure, virtuous functions are marked with a halo.

Trinity value types (true, false, spiritual) can be used to map real entities to virtual functions.

Passing by reference is achieved using the chapter, verse, line notation.

Transcendental functions are used to access higher level objects.

Mistakes never need to be fixed and the confessional exception handler ensures program execution can continue unhindered by any previous activity or state.

Collections are managed through the powerful Chalice class, considered by many to be the holy grail of stl containers.

An acolyte function can be used where an over developed and complex object has difficult side effects; this is technically referred to as sublimation (while never documented this is actually an implementation of the choir boy pattern).

A master of these techniques is revered as a divine architect. ■

Enum – a misnomer (continued)

Enumerators of **enum** types occupy a unique place within the language in that they are pukka language elements with meaningful values, but they are strictly compile-time quantities. They occupy no storage and so have no address, which is why they are so suitable for holding values in template metaprogramming. One can use static **const** integers instead of **enum**s in TMP, but there may be an overhead. Listing 11 shows the well-known TMP factorial code example. rewritten to use static **const** unsigned values instead of **enum**s. The code works as expected, and in this case the compiler optimizes away the storage allocated for the constants in the two templates (when built with optimization turned on) so there is no penalty.

Summary

When considering the **enum** type in C and C++, don't allow yourself to be fooled by its name!

Listing 11

```
template <unsigned N>
struct Factorial
{
  static const unsigned value =
     N * Factorial<N - 1>::value;
};
template <>
struct Factorial<0>
{
  static const unsigned value = 1;
};
```

It is not an enumeration type (at least not by any sane (and non-recursive) definition) because it allows the definition of values that are unordered and non-contiguous, and which therefore do not lend themselves readily to enumeration. It is nevertheless possible – Wilson has shown us how – to use an **enum** as the basis for a datatype that can be enumerated.

The properties that make **enum** unsuitable for enumeration do have their uses, however, for defining groups of named compile-time constant values without allocating any storage. ■

References

[1] Matthew Wilson: 'Enumerating Experiences' *CVu* 23.4. September 2011.

[2] *Shorter Oxford English Dictionary*. Oxford University Press.

[3] Niklaus Wirth: *The Programming Language PASCAL – Revised Report*. ETH Zurich, 1973

[4] Niklaus Wirth: *Modula-2*, ETH Zurich, 1980.

[5] Brian Kernighan & Dennis Ritchie: *The C Programming Language*. Prentice Hall, 1978.

[6] Brian Kernighan & Dennis Ritchie: *The C Programming Language*, Second Edition. Prentice Hall, 1988.

[7] Bjarne Stroustrup: *The Design and Evolution of C++*. Addison Wesley, 1994.

Code samples accompanying this article were compiled and tested with gcc (v4.4.5), g++, fpc, gnat, or gm2, as appropriate. The scoped enum code was compiled with the -std=c++0x switch.

C++ Standards Report 11

Roger Orr reports on the new C++ standard.

As anticipated in the last CVu we have a new C++ standard (snappily known as 'ISO/IEC 14882:2011') and the PDF can now be purchased from the ISO website for a 'mere' 352 CHF. National bodies will also make the standard available in due course and we are exploring trying to get the standard printed in the UK for a somewhat more realistic price (the 2003 standard was published by Wiley this way for £35). Watch this space!

We have also had a blog posting from Microsoft with news of the features of C++11 that will be in the next version of Visual Studio (http://blogs.msdn.com/b/vcblog/archive/2011/09/12/10209291.aspx).

While it is good that a number of 'C++0x' features are already in VS 2010, I was rather disappointed with the small number of extra features that will be added for the next release. I suspect enough customers will have to ask about the missing features before there is enough commercial pressure to implement them. Users of g++ have much better coverage (http://gcc.gnu.org/projects/cxx0x.html).

Call for work items

The August C++ standards committee meeting was a bit more relaxed than the previous few meetings had been since the ink is barely dry on new standard.

The main business in the core language working group was with wording changes, mostly minor, to remove ambiguities or small problems. People trying to implement the new C++11 features had raised some of these issues as they uncovered problems (or potential problems) with the new wording. Work on any more substantial new core language features will wait for further meetings to decide which (if any) such items should be considered.

Walter Brown presented a paper describing an ambiguity in the C++ handling of conversion operators – one of his examples was a **zero_init** class such that:

```
zero_init<int> i;
i = 7;
switch( i ) { ... } // fails to compile
switch( i+0 ) { ... } // compiles
```

Perhaps this code will appear in a future Code Critique column!

There was more new work in the library working group as they discussed five papers for future library extensions: filesystems, **shared_lock**, permutations of partial elements of set, I/O for duration types and date time. They also issued the following general call for proposals:

> The C++ committee Library Working Group welcomes proposals for library extensions which will be considered starting in the February 2012 meeting. We have not yet set out an overall timeline for future library extensions, but are ready to consider new proposals at this point.
>
> To increase the chances of your proposal being accepted by the committee, we strongly recommend that a committee member willing to champion your proposal (this could be you yourself, or a delegate) attend upcoming meetings to help shepherd your proposal through the process.

Please take note of this if you have a C++ library that would be suitable for standardisation and would be prepared to put in some of the work for the process. You could contact me (or other members of BSI C++ panel) in the first instance. As with the C++11 standard, it is likely that many of the new library features will be implemented in publicly available repositories, such as boost, to provide experience and feedback from use in real programs.

ROGER ORR

Roger has been programming for over 20 years, most recently in C++ and Java for various investment banks in Canary Wharf and the City. He joined ACCU in 1999 and the BSI C++ panel in 2002. He may be contacted at rogero@howzatt.demon.co.uk

Inspirational (P)articles

Frances Love introduces Paul Grenyer.

This time Paul Grenyer tries to disagree with Steve Freeman and Nat Pryce, and realising the error of his ways changes his perspective and writes his database tests in a new way. Engaging with a subject often involves arguing with people only to realise they are right in the long run. Have you changed perspective on something recently, or tried arguing only to realise you were wrong? Then write CVu an inspiration (p)article sharing the details. Contact frances.buontempo@gmail.com.

So Long and Thanks for all the Transactions

I'm a big fan of integration testing data access layers using transactions. Very simply you start a transaction, clear out put any necessary data into the database, run the test against it and roll back the transaction putting the database back to its original state. The advantage is a known database state every time you run the test.

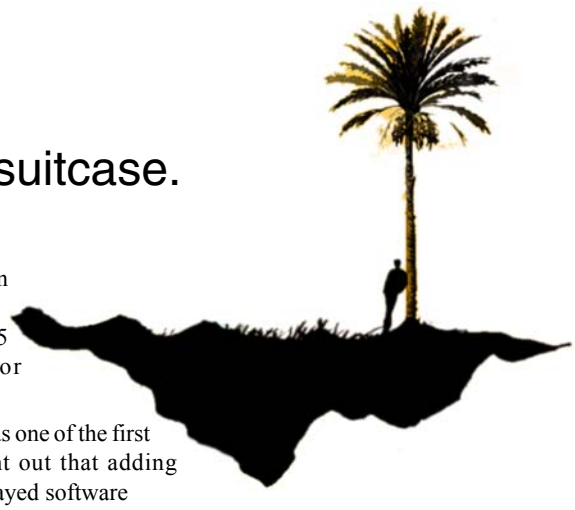
I was very surprised when I read in *Growing Object Orientated Software Guided by Tests* that integration tests should not be run in a transaction. The database should still be cleaned out and have necessary data inserted, but it is not rolled back after the tests. The two main advantages are that the tests run in an environment closer to production and resulting database state can be used to help solve those awkward bugs.

Another advantage of transactions is that manual and automated system tests can use the same database as the integration tests without the integration tests destroying all the data needed for the other tests. I started discussing why I liked the transaction approach with Steve & Nat. Nat pointed out that the solution was to have two databases. One for system and manual testing and one for integration testing. The creation of the database for your application should be scripted and automated anyway, so keeping the structure, reference data and test data synchronised should be easy.

This was clearly the solution and completely changed how I felt about transactions. Where possible my future projects will have two databases and fewer integration test transactions.

Desert Island Books

Roger Orr shares the contents of his suitcase.



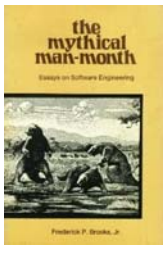
I can't actually remember the moment I met Roger Orr for the first time. I thought it was probably at a C++ panel meeting or at an ACCU conference. Roger thinks it was on the platform at Oxford station on the way back from one of my first conferences. I'm ashamed to say I cannot remember this meeting at all, but I was still drinking then and everything immediately following a conference was usually quite hazy.

Regardless of how we met, I have this feeling that Roger has just always been there providing the steady hand of common sense. He is the current organiser of the ACCU Canary Wharf lunch. Most recently, although in different teams, Roger and I have been working for the same bank. And of course he also edits CVu's very own code critique and takes an active role in the C++ standards committee.

Roger Orr

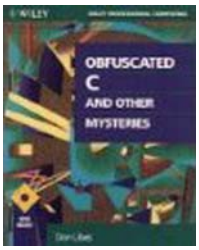
I like the idea of 'Desert Island Books' and it has been fascinating to hear about the wide range of books people have listed. Inevitably enough there are a few books that just keep coming up: and so my first book duplicates one of the ones that Chris O'Dell covered in May's *CVu*.

I had a six month job, way back in 1978, as a 'trainee computer programmer' in the gap between finishing at school and starting at Uni and I worked in a team of ten or so programmers writing programs on a mini computer. I was assigned to someone in the team to teach me to program and, looking back, I was incredibly fortunate in having the mentor I got. Dave Buckle was a good programmer and was a very good example from whom to learn the craft of programming. In addition to learning from him in person, over those six months he lent me several books on programming – I couldn't now recall the content of them all but I do recall a few: there was Jackson's *Structured Programming* book and a book on writing structured programs in Fortran using 'RatFor' (Rational Fortran: a preprocessor for Fortran). Although these particular books are now quite old and technology has moved on a long way, the lessons Dave taught me about keeping interested in the subject and reading more broadly than just your current experience of programming have stood me in good stead since.



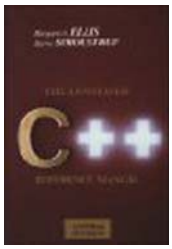
He also lent me my first Desert Island choice: *The Mythical Man Month* by Fred Brooks, which is still just as relevant as it was when I first read it as a relatively new book. I consider this is one of the 'must read' books in the programming world. It is a bit sad to realise that although it was written in 1975 we still haven't learned the lessons. For those of you who haven't read it ... put down the magazine now and go and order it! It was re-issued as an anniversary edition in 1995 and is still for sale.

Fred Brooks was one of the first people to point out that adding people to a delayed software project makes it later and he also coined the term 'second system syndrome' to describe the danger of over-engineering the second version of a program by trying to fit *all* the features there wasn't time to put into the first version. Both these problems still seem to be alive and well in today's world of software engineering.



My second book comes a few years later when I was programming in 'C' on PCs. I read a book review in the EXE programming magazine where the actual text of the review made a shape on the page and the review ended with something like 'whatever you do, buy this book'. I was soon the proud owner of *Obfuscated C and other mysteries* by Don Libes – a book unlike any other I'd come across. The chapters alternated between describing entries in the annual obfuscated C competition (now defunct, but see www.ioccc.org) and chapters on general C programming issues such as 'Keeping Track of Malloc' and 'Byte Ordering'. The book is an entertaining read but also very informative. It also opened my mind to some of the creative things you could do with a programming language and how you can abuse the rules and (sometimes) get away with it.

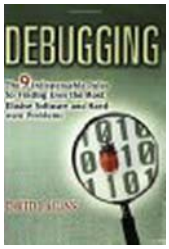
(Incidentally EXE magazine is the reason I'm a member of ACCU: Francis Glassborow's regular column in that magazine kept mentioning this organisation called 'ACCU' and eventually I decided to investigate further. The rest, as they say, is history. I wonder how many other members of ACCU arrived down the same route!)



Programming in C gradually morphed into programming in C++ and this leads me on to my third book, commonly known as the ARM. *The Annotated C++ Reference Manual* by Bjarne Stroustrup and Margaret Ellis was for some years the definitive book for the C++ programming language. It has now been superseded by the ISO standard which first appeared in 1998 but for much of the 1990s this book defined the C++ language.

It was the book I learned the language from. Now I know most normal people would learn a language from a tutorial book but I was perfectly happy to read through the reference manual and try to make sense of it. Little did I suspect that later on I'd be sitting in committees revising the wording of the ISO C++ standard!

One of the things I enjoy most about programming is finding and fixing bugs; particularly when the relationship between the symptom and the cause is obscure. It's a bit like a puzzle: you know there must be an explanation for the behaviour you observe in the program but it just doesn't make sense...yet. There are very few good books about debugging despite the large amount of time that most programmers spend doing it.



I was delighted to come across my fourth book, simply titled *Debugging* by David Agans. He wrote 'I intended

What's it all about?

Desert Island Disks is one of Radio 4's most popular and enduring programmes. The format is simple: each week a guest is invited to choose the eight records they would take with them to a desert island (http://www.bbc.co.uk/radio4/factual/desertislanddiscs.shtml).

The format of 'Desert Island Books' is *slightly* different from the Radio 4 show. You choose about five books, one of which must be a novel, and up to two albums. Some people even throw in the odd film. Quite a few ACCUers have chosen their Desert Island Books to date and there are plenty more to go.

The rules aren't too strict but the programming books must have made a big impact on your programming life or be ones that you would take to a desert island. The inclusion of a novel and a couple of albums helps us to learn a little more about you. The ACCU has some amazing personalities and Desert Island Books has proved we only scratch the surface most of the time.

Each issue of CVu will have someone different. If you would like to share your Desert Island Books please email me: paul.grenyer@gmail.com.

Memories of Learning C

Anthony Williams recalls his first experiences of C.

I studied Physics at college, and there was very little programming taught as part of the course. That didn't bother me though; I'd taught myself to program up until then, and I wasn't going to stop now. The big benefit I got from computing at college was access to the internet, and access to C and C++ compilers. I could program in BASIC, Pascal and a couple of forms of assembly language, and I'd eagerly read Stan Lippman's *C++ Primer* and written out (on paper!) some C++ code, but I hadn't yet had a C++ compiler to try out my programs on.

I wrote several C++ programs before I even considered writing a plain C program, but I probably typed in and compiled the classic `printf("hello world\n");` C program to check everything was working before I compiled any C++.

Usenet

My strongest memories about learning C are about learning from usenet. Though I had access to C compilers at college, access to experts was not so readily available unless you were studying computing. With access to the internet, I didn't need local experts though – usenet provided access to experts from across the world. I read comp.lang.c and comp.lang.c++ avidly, and taught myself both languages together. The usenet community was invaluable to me. The wealth of knowledge that people had, and their willingness to share with newbies was something I really appreciated.

I remember struggling over file handling, and getting the arguments to `scanf` right; I remember puzzling over the poor performance of a program and having someone kindly point out that my code was doing `malloc` and `free` calls in a tight loop. Though I tend to answer more questions than I ask these days, I still hang out on newgroups such as comp.lang.c++ today. It seems that for many people StackOverflow has replaced usenet as the place to go for help, but the old-style newsgroups are still valuable.

Ubiquity

Back then, C++ compilers were in their infancy. Templates didn't work on every compiler, there was no STL, and many platforms didn't have a working C++ compiler at all. I consequently wrote a lot of C – every platform had a C compiler, and my C code would work on the college PCs, my PC (when I saved up enough to buy one), the University's Unix machine, and the Physics department workstations. The same could not be said for C++.

The ubiquity of C is something I still appreciate today, and this is only possible because Dennis Ritchie designed his language to be portable to multiple platforms. Though 'implementation defined' behaviour can be frustrating when the implementation defines it a different way to how you would like, it is this that enables the portability. You want to write code for a DSP that only handles 32-bit data? Fine: make `char`, `short`, `int` and `long` all 32-bits. What if your machine has 9-bit bytes? No problem: just make `char` 9 bits, and everything else a convenient multiple of that.

C is the basic lingua-franca of the computing world. It is a 'portable assembly language'. These days I use C++ where I can because it allows a higher level of abstraction, and easier expression of intent without compromising on the performance you'd get with plain C, but it's not as portable, and wouldn't be possible without C.

The computing world owes a lot to Dennis Ritchie..

Dennis Ritchie 1941–2011

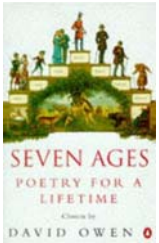
Dennis MacAlistair Ritchie – often known simply as DMR – died aged 70 on 12 October 2011. His contributions to the world of computing can hardly be overstated; as the co-inventor of Unix and C his influence is in nothing less than the idea of portable operating systems and systems programming. His achievements attracted many awards including the ACM Turing Award, the ACM Software Systems Award and the U.S. National Medal of Technology (all awarded jointly with Ken Thompson).

His work inspired a generation of programmers, and is the bedrock of so much that we, as programmers, depend on.

Desert Island Books (continued)

to teach the essential and universal techniques of debugging ... I demonstrated this by using examples in various disciplines including hardware and software, cars, houses, and even human bodies.' His point was that a lot of debugging comes down to some simple rules that are applicable to many different kinds of problem solving. I suspect, on this mythical desert island, I could use the same techniques to solve some of the problems I would be likely to come across thrown up by daily life.

I thought about what novel I would like to take to my desert island, and decided that it was too hard to decide: there are so many I'd like to have with me! So I decided I'd do something different and take a poetry anthology: *Seven Ages: Poetry for a Lifetime* by David Owen. This was the book I took with me on a trip to Tanzania in 2000 and is a great book if you can only take one: there are hundreds of poems in it loosely grouped around the seven ages of man from Shakespeare's famous poem starting 'All the world's a stage, And all the men and women merely players, They have their exits and entrances, And one man in his time plays many parts, His acts being seven ages.' What made it, for me, a great book for travelling with was it could take a very long time to read; you read a poem, perhaps read it again, and then think about it.



Finally some music. I'm really not sure what to choose. I spent much of my student years working to various Beatles compilations; that would still be one option. Alternatively my most recent purchase might be an interesting one to pick: *Tres Tres Fort* by Staff Benda Bilili. This band are a group of paraplegic musicians living around the Zoo in Kinshasa. Many of the instruments are made or adapted by themselves and the music is quite unusual, but full of life. Perhaps it would inspire me to try and make some music myself with whatever I could find on my desert island!?

Next issue: Ola Mierzejewska

Code Critique Competition 72

Set and collated by Roger Orr. A book prize is awarded for the best entry.

Please note that participation in this competition is open to all members, whether novice or expert. Readers are also encouraged to comment on published entries, and to supply their own possible code samples for the competition (in any common programming language) to scc@accu.org.

Last issue's code

I'm trying to write a simple circular list – it is like a std::list but it wraps at each end just like days of the week do. However, when I try to go on five days from Wednesday I reach Sunday, not Monday. Please help!

```
cc71>circularListTest
Today is Wed
Yesterday was Tue
5 days time will be Sun
```

`circularList.h` is in Listing 1 and `circularListTest.cpp` is in Listing 2.

Listing 1

```
#include <list>

template <typename T>
class circular : public std::list<T>
{
  typedef std::list<T> list;
public:
  class iterator;
  circular() {}
  template <typename IT>
  circular(IT beg, IT end) : list(beg, end) {}
  iterator begin() { return iterator(*this); }
  iterator end() { return --begin(); }
  // iterator implementation details
  class iterator : public list::iterator
  {
    list & parent;
    typedef typename list::iterator super;
  public:
    iterator(list & par)
    : parent(par), super(par.begin()) {}
    using super::operator=;
    // modifiers
    iterator& operator++()
    {
      if (*this == parent.end())
        *this = parent.begin();
      else
        this->super::operator++();
      return *this;
    }
    iterator& operator+=(int n)
    {
      while (n-- % parent.size())
        ++*this;
      return *this;
    }
```

Listing 1 (cont'd)

```
    iterator& operator--()
    {
      if (*this == parent.begin())
        *this = parent.end();
      else
        this->super::operator--();
      return *this;
    }
    iterator& operator-=(int n)
    {
      while (n-- % parent.size())
        --*this;
      return *this;
    }
    // derived operators
    iterator operator++(int)
    {
      iterator it(*this);
      ++*this;
      return it;
    }
    iterator operator+(int n)
    {
      iterator result(*this);
      return result += n;
    }
    iterator operator--(int)
    {
      iterator it(*this);
      --*this;
      return it;
    }
    iterator operator-(int n)
    {
      iterator result(*this);
      return result -= n;
    }
  };
};
```

Listing 2

```
#include "circularList.h"
#include <algorithm>
#include <iostream>
#include <string>
using std::string;
void test(circular<string> s)
{
  circular<string>::iterator it =
    std::find(s.begin(), s.end(), "Wed");
```


ROGER ORR

Roger has been programming for over 20 years, most recently in C++ and Java for various investment banks in Canary Wharf and the City. He joined ACCU in 1999 and the BSI C++ panel in 2002. He may be contacted at rogero@howzatt.demon.co.uk

Listing 2 (cont'd)

```
  std::cout << "Today is " <<
    *it << std::endl;
  circular<string>::iterator yest = it - 1;
  std::cout << "Yesterday was " <<
     *yest << std::endl;
  int const n = 5;
  it += n;
  std::cout << n << " days time will be "
    << *it << std::endl;
}
int main()
{
  circular<string> s;
  s.push_back("Sun");
  s.push_back("Mon");
  s.push_back("Tue");
  s.push_back("Wed");
  s.push_back("Thu");
  s.push_back("Fri");
  s.push_back("Sat");
  test(s);
}
```

Critiques

Paul Floyd <Paul_Floyd@mentor.com>

This is an 'out by one# style error. The problem is with `operator++`

```
iterator& operator++()
{
  if (*this == parent.end())
    *this = parent.begin();
  else
    this->super::operator++();
  return *this;
}
```

which is saying 'if it's at the end, wrap to the beginning, otherwise increment'. When this is called at `end()-1`, it increments to `end()` and returns that. A circular list should have no end! It is only on the next call to `operator++` that the wrapping takes place. So it takes two calls to `operator++` to wrap from `end()-1` to `begin()`.

Instead, when this is called at `end()-1`, it should increment then test whether it is at `end()` and if so wrap:

```
iterator& operator++()
{
  this->super::operator++();
  if (*this == parent.end())
    *this = parent.begin();
  return *this;
}
```

There is a similar problem with `operator--` which should be

```
iterator& operator--()
{
  if (*this == parent.begin()) {
    *this = parent.end();
    this->super::operator--();
  }
  else
    this->super::operator--();
  return *this;
}
```

Peter Sommerlad <peter.sommerlad@hsr.ch>

The main problem of our student this time is, that he or she doesn't understand the concept of C++'s iterators well enough. Luckily or unfortunately, STL's designer(s) did choose a design that mimics the behaviour of pointers. In contrast to, for example, Java or D, that define a single object to denote a range of iteration, C++'s STL uses two iterator objects or two pointers to denote a range representing its beginning and ending. The interesting part then is that the end is marked by a pointer/iterator that is one PAST the end of the underlying sequence. This means accessing a container's `end()` iterator is usually undefined behaviour. And that seems to be the problem of the code on first look. So the own iterator uses that undefined `end()` iterator as one of its steps, this then results in ending one weekday too early. Fortunately, the test program doesn't access the `*end()` element and thus does not format my disk or rain pink elephants which might be the case in doing such undefined behaviour.

So the iterator range between `begin()` and `end()` actually seems to be something like:

Sun Mon Tue Wed Thu Fri Sat <<`end()` place>> Sun Mon Tue ....

That explains, why adding 5 days to Wednesday results in Sun instead of the expected Mon.

A bigger problem is that the code inherits from standard library classes that are not intended to be inherited from. Since the containers and iterators are not using virtual member functions, such inheritance can be dangerous, especially if additional member variables are defined, as is the case with `circular::iterator`.

Linticator also shows some warning about that:

```
template <typename T>
class circular : public std::list<T>
```

i 1790: Base class 'std::list<std::basic_string<char>>' has no non-destructor virtual functions

Also using the super class' assignment operator is dangerous as well in such a case, because the new member variable never gets overwritten with such an assignment.

But now, let us start a more thorough analysis:

A quick observation is, that the header file lacks an `#include` guard. That can be an omission to save space in cvu, but shouldn't be in real header files to avoid double inclusion and thus violation of the one-definition-rule of C++. Some compilers support `#pragma` once instead, but I would prefer to stick with the standard mechanism of an internal `#include` guard. Some 'classics' recommend external `#include` guards, but the reason for them is no longer valid, since modern compilers automatically detect multiple includes and will not parse the files with internal `#include` guards again.

Now my compiler tells me the following (slightly simplified):

```
g++ -O0 -g3 -Wall -c -fmessage-length=0 -MMD
  -MP -MF"scc71.d" -MT"scc71.d" -o "scc71.o"
  "../scc71.cpp"
In file included from ../scc71.cpp:1:0:
  ../circularList.h: In constructor
  'circular<T>::iterator::iterator(...)':
../circularList.h:18:42:   instantiated from
  'circular<T>::iterator circular<T>::begin()
../scc71.cpp:11:22:   instantiated from here
../circularList.h:24:11: warning:
  'circular<...>::iterator::parent'
  will be initialized after [-Wreorder]
../circularList.h:28:36: warning:   base
  'std::_List_iterator<...>' [-Wreorder]
../circularList.h:27:4: warning:   when
  initialized here [-Wreorder]
```

This strange message provides the information that the initializer list of the constructor `iterator(list &)` is in the wrong order. First all base-class elements are initialized for a class, then the member variables in the order of their definition. A further problem of that constructor is that the list is passed and kept as a reference. This can be problematic, if an iterator object survives its 'parent' list.

Nevertheless, exchanging the order of the initializer list elements cures that warning:

```
iterator(list & par)
:  super(par.begin()),parent(par) {}
```

However, that doesn't fix the behaviour, just the compilation warning.

The inheriting iterator class is one of the major problems. So let us first encapsulate the `list::iterator` as a member instead of inheriting it. This way we loose the inherited `operator*`, `operator!=` and `operator==`, but those are trivially to implement. In addition we need to inherit from `std::iterator` to obtain the traits required for the standard algorithms:

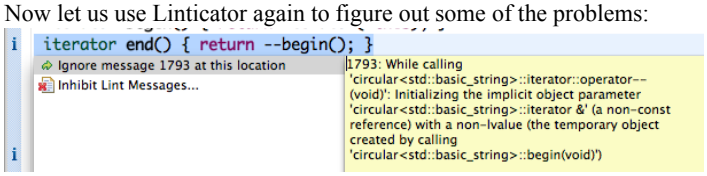
```
// iterator implementation details
class iterator : public std::iterator<
  std::bidirectional_iterator_tag,T>
{
  typename list::iterator iter;
  list & parent;
  typedef typename list::iterator super;
public:
  iterator(list & par)
  : iter(par.begin()),parent(par) {}

  typedef typename list::value_type
    value_type;
  value_type operator*() const {
    return *iter;
  }
 bool operator==(iterator const &other)const
 {
   return iter == other.iter;
 }
  bool operator!=(iterator const &other) const
  {
    return !(*this == other);
  }
```

Now, before we fix everything, let us first simplify the code. To write your own iterators I recommend to my students using boost's iterator helpers from `boost/operator.hpp`.

This will eliminate some of the operator overloads. Inheriting from `boost::bidirectional_iterator_helper<T>` will give us the overloads for `!=` and postfix `++` and `--`. In addition we can use `boost::addable` and `boost::subtractable` to obtain `+` and `-` from `+=` and `-=`.

```
class iterator : public
  boost::bidirectional_iterator_helper<
    iterator,typename list::value_type>
, public boost::addable<iterator,int>
, public boost::subtractable<iterator,int>
{
  iterator end() { return --begin();
}
```

Now let us use Linticator again to figure out some of the problems:



Further explanations of Linticator shows us that we are using a temporary for applying `operator--()`. A better approach and a generically working one, would be to use a local iterator variable instead and `std::advance` to navigate it:

```
iterator end() { iterator it(begin());
  std::advance(it,-1); return it;}
```

Now let us fix the logic. To safely wrap around, we must never reach the underlying list's `end()` iterator. This can be done as follows:

```
iterator& operator++()
{
  ++iter;
  if (iter == parent.end())
    iter = parent.begin();
  return *this;
}

iterator& operator--()
{
  if (iter == parent.begin()) {
    iter = parent.end();
  }
  --iter;
  return *this;
}
```

et voilà, the output now is:

```
Today is Wed
Yesterday was Tue
5 days time will be Mon
```

Now some further cleanup, e.g., getting rid of the potentially error-prone loops, especially if `n` is negative (which might still be an error, but I ignore that for now):

```
iterator& operator+=(int n)
{
  std::advance(*this, n% parent.size());
  return *this;
}
iterator& operator-=(int n)
{
  std::advance(*this,n % parent.size());
  return *this;
}
```

There are further issues, like considering making iterator a `const_iterator` instead, or providing that in addition. A non-const overload of `operator*()` is missing:

```
value_type& operator*() {
  return *iter;
}
```

And the circular class is still inheriting from `std::list`. The `test()` function is not nearly close to a good set of unit tests, one can write with CUTE. In addition there are further lint messages one can deal with, but for the moment I've chosen the option to ignore them, because I've run out of time and the deadline is too close for me to further fix that. Maybe some other submitter explains that to you as well.

Balog Pal <pasa@lib.hu>

This entry won my heart with its first sentence. It so much resembles the favorite approach from clients, asking for a very simple something, that is exactly like some existing program or feature, just has a small difference. And obviously expect me to have one in no time built on top of the designated candidate.

A software engineer certainly must have experience to call an immediate red alert, all shields up and slow to impulse. A difference may look small expressed in English, or drawn in paper, but in software design it may be breaking a fundamental. Murphy's rule suggests that it normally does too. So our first task here is to clear the mind, step back to requirements, find an implementation candidate using tabula rasa, only then look at the original proposal on similarity. If we could really use the 'similar' thing, hooray, and if the change is really small, trivial. But it does not happen very often.

So here we're suggested that a 'circular list' is exactly like a linear list. You know, a circle is exactly like a line. Just bend it, and join the ends, so it forms a circle. In geometry you would use that similarity, do you? Or in topology? Well? We can list similarities? Just the list will not be so huge.

Our patient fell in the trap. Here we indeed have similarities, that can be expressed as "we want the interface of this collection be like std::list's." Just as many collections in STL have similar interface. list and vector both have many matching functions and concepts. Certainly they are not implemented in terms of each other.

In the presented code we see public derivation from `list` and `list::iterator` to our more specific class. Most STL classes are not created to act as base classes. They don't have virtual destructors or virtual functions. It is not strictly forbidden to use them as such, but we shall be extremely careful even in cases where we actually have an is-a relation. In use we may face slicing, Janus-faced behavior and other confusions. Before going that way we should read up the rationales of the common do-not suggestions and make sure our case plays as exceptions, or we mitigated the problems some way. We shall re-visit this question after we decided that subclassing would be good in theory.

So, first fundamental question is to see whether circular-list IS A `std::list` really. `std::list` is a 'reversible sequence container'. Reading the requirements in the standard I set warning flags on `begin()`, `end()`, `size()`. At reversible container section I have serious doubts our code took it into consideration. Then I get to section 23.1.1, 'Sequences'. Starting 'A sequence is a kind of container that organizes a finite set of objects, all of the same type, into a strictly linear arrangement.'

This sounds like a show-stopper unless we can come up with really good explanation how a circle will look strictly linear. In our circular list, any closed subrange indeed looks like a list. But what about beginning and end? A true circle does not have that notation at all.

We may try to force our idea, to chose an arbitrary element to call beginning. That will designate a matching end too. It would even work fine with interface using closed ranges. But STL uses half-open ranges, for `end()` we shall return a one-past element. Following our design philosophy we should return `begin()` here, as that is the element following `closed_end()`. Too bad it will break `size()` and `empty()`.

The submitted code tries to smuggle out `end()` of the original list, a virtual element that is not really there. That saves the day for `size()` and the use cases like 'full dump' of the list content. But it breaks the circularity.

The purpose of the whole thing was to have our iterators wrap around. So that `++closed_end()` returns `begin()` and we can go ahead; similarly in other direction. In `operator ++` of the iterator we face a dilemma. What to give from our virtual end element? Go to `begin()` by the circular requirement, or fall to `list::end()` for the sequence container's.

I see no resolution to this dilemma and that sends the whole implementation idea down the drain. And really not just the implementation, but the design too. We certainly can design and implement a circular container that works fine. But you must go the extra mile to draw its interface. I suggest removing elements that would make it look like a STL sequence and cause confusion. Possibly have them by a different, distinctive name.

I don't submit a solution, as it would take huge amount of code, and implementations for circular lists must exist freely accessible. Not even just a design, as it is an open-ended thing, the patient shall make decisions on use cases to support and keep stuff in/out accordingly. Just a few hints.

- `circular` shall not have a public base class from STL. It can still use `std::list` as member or a private base class, reusing many functions through delegation or a `using` declaration
- if the interface resembles a STL collection, violently advertise it is not a sequence, possibly not even a 'standard collection'.
- if a function is kept with the same name as in a collection, it must be proper semantic equivalent, without any doubt on behavior, especially no dilemmas
- `iterator` shall not derive from `list::iterator` but may derive from `std::iterator` that was created for that purpose
- I would not include a function named `end()` with that name (by collection requirements). I'd keep `begin()` only with a compelling use case.
- if the implementation is done using list, I'd be tempted to provide `seq_begin()` and `seq_end()`. At least for a tamed form, returning `list::const_iterator` for 'special use' only like dumping the content, etc. It is a double-edged sword with some pros and many cons. It breaks encapsulation and locks in the implementation, but is worth careful consideration.
- do comprehensive tests on `rbegin()` and company. The original version just left them as inherited from list, I doubt with sensible results ;-)
- in the implementation of `iterator+=` modulo better be done as first thing.
- I'd probably just drop relation operators (on circular) as useless baggage, if used, test profoundly to avoid endless loops
- IRL circular lists are often implemented having a sentinel node, that serves as pre-start and post-end element. The sentinel itself is a big burden, but may help dealing with `end()`-related cases if design did not allow to drop them

Huw Lewis <huw.lewis2409@gmail.com>

Well done to the developer for a good first stab at this. It is a neat idea to use the list container and its iterator type. It is a good start to base the implementation on reusing well known code and interfaces.

First I'll deal with the error seen in the test results. The error is in the iterator's increment operator. It considers 'end' to be the last item in the sequence rather than 'one past the end' that it really is. The iterator has a reference to the `std::list`, not the `circular<>` concrete type. A simple re-write of the pre-increment operator puts this right:

```
iterator& operator++()
{
  this->super::operator++();
  if (*this == parent.end())
    *this = parent.begin();
  return *this;
}
```

The test results are now as expected. However, this test is only the start. There is plenty still to do. I aim to find the implementation's vulnerabilities through adding more tests.

What about handling an empty list? The code looks like it might be a little error prone here due to the `circular::end` method not behaving as a standard `end` method. However, my `test_empty_list` function does pass. I think that it is not reasonable to perform circular iteration operations on empty lists or invalid iterators. An exception should be thrown in this instance.

Ok, another attempt to break the code – what about searching for the last item in the list, `"Sat"`? I expected this might be incorrect – again because the circular end method returns the last item, not the 'one past the end' item. However, this test also works. Why is this? I would have expected the find algorithm to stop the search at the list end, and also for the '`it == end`' validation check to be true i.e. the iterator is invalid. It turns out there is a bug in the `operator--()` method. When we're at the beginning of the sequence, we want to skip to the last item in the sequence, but the code actually assigns the value to `end` (one past the end). A simple fix is:

```
iterator& operator--()
{
  if (*this == parent.begin())
  {
    *this = parent.end();
  }
  this->super::operator--();
  return *this;
}
```

Now my test fails as I originally expected: the last item `== end()`, so the traditional iterator validity check is flawed. Maybe I could add a new `isValid` method to return true if the iterator is not `parent.end()` (one past the end).

My next test (searching for a non-existent string) shows that the above isn't good enough. The **std::find** algorithm returns the end iterator given to it, which is actually the last item, not the 'one past the end'. So we are asking something quite unreasonable from the algorithm.

At this point, it is worth thinking about the design. It is a usable interface? It does the circular iteration just fine, but cannot realistically be used where there is a chance of the iterator being or becoming invalid e.g. **find**, **erase** etc. It also shows that it is not suitable where we would want to perform some algorithm on the sequence e.g. **std::find**.

I think that the standard list interface is what is required for almost all operations (except the circular iteration). The circular iterator should be used as exception rather than the rule.

With that in mind, I have re-written the circular iterator arithmetic operators as simple template functions (see below.) Although this does not give us the familiar '**++it**' interface, it provides quite a few other benefits including:

- Compatibility with any type of iterator, including **const_iterator** types.
- Compatibility with any type of std container, not just **std::list**
- None of the issues (experienced above) with 'one past the end' are a problem.

```
/**
 * increment circular iterator
 */
template <typename C, typename I>
I& circular_increment(C& container, I& it)
{
  if (it == container.end())
    throw BadCircularIterator(
      "Cannot increment invalid iterator");

  if (++it == container.end())
  {
    it = container.begin();
  }
  return it;
}

/*
 * Add n to the iterator it.
 */
template <typename C, typename I>
I circular_add(C& container, I it,
    std::size_t n)
{
  while (n-- % container.size())
    it = circular_increment<C, I>(container,
           it);
  return it;
}

/*
 * Decrement the circular iterator it
 */
template <typename C, typename I>
I& circular_decrement(C& container, I& it)
{
  if (it == container.end())
    throw BadCircularIterator(
      "Cannot decrement invalid iterator");

  if (it == container.begin())
  {
    it = container.end();
  }
  --it;
  return it;
}

/*
 * Decrease the iterator it by n
 */
template <typename C, typename I>
I circular_minus(C& container, I it,
    std::size_t n)
{
  while (n-- % container.size())
    it = circular_decrement<C, I>(container,
           it);
  return it;
}
```

Frances Buontempo <frances.buontempo@gmail.com>

I can solve the initial problem with one simple change. Remove the **else** from the pre-increment operator.

```
iterator& operator++()
{
  if (*this == parent.end())
    *this = parent.begin();
  else//REMOVE
    this->super::operator++();
  return *this;
}
```

Problem solved. I wonder if this means the pre-decrement operator has a similar problem? Some moments thought, or at least another test, will reveal more problems.

```
circular<string>::iterator it =
  std::find(s.begin(), s.end(), "Wed");
circular<string>::iterator it_trouble =
  std::find(it, s.end(), "Tue");
if( it_trouble!=s.end() )
    std::cout << *it_trouble << '\n';
else
    std::cout << "Tue not there \n";
```

The circular list does not find **"Tue"**. Starting on Wednesday, then I would expect a circular list to find Tuesday eventually, if it circles. This is the crux of the matter. If I want to use the container in the standard algorithms, they expect to have a **begin** and an **end**. The code provides **end**

```
iterator end() { return --begin(); }

iterator& operator--()
{
   if (*this == parent.begin())
     *this = parent.end();
  else
     this->super::operator--();
   return *this;
}
```

So, **end** is actually the end of the **std::list**. This means the standard algorithms won't circle round the container, unless I do something hacky to add a guard item one before where we start the algorithm, and try to remove it when I think you have finished.

We need to step back and decide how we want to use this container. If I wish to use it in an algorithm like **find**, I must provide an **end**. If we want to circle, we want end to go back to the beginning. If I then try to search for something that isn't in the container, any algorithm that tries to walk from the beginning to the end will never terminate. This gives us two conflicting requirements. If the circular buffer provides a **circular_iterator** along with the normal iterator this might save the day. Though any attempt to find or walk the whole container is likely to end up iterating forever if the user isn't very careful. Of course, we should also be providing **const_iterator** versions too.

Perhaps the best way forward is to provide a member **find**, which will do one full sweep from any starting point in the container.

```
bool find(iterator & first, const T & value)
{
  size_t count = 0;
  for (; count != contents.size();
      ++count, ++first)
    if (*first == value)
      break;
  return count != contents.size();
}
```

This will find Tue if we start at Wed, and will report **false** if we search for something that isn't there. This doesn't match the usual standard find algorithm, but a truly circular container doesn't have an end to compare against.

Now we have seen the main problems, we should remember Sherlock Holmes' advice never to derive from classes without virtual destructors, including standard containers. (*CVu* Issue 12 V 5, 2000, http://accu.org/index.php/journals/c124 or journals/1063). Or maybe it wasn't Sherlock Holmes, but the point still stands. It makes more sense to *contain* a **list**, or possibly **vector** if we want to skip to random places say by using **it += 5**, rather than derive from a container.

In conclusion, you should try Python's list slice and look at boost's **circular_buffer** for inspiration and start over.

Commentary

This problem consisted of three separate, but related issues. The first was the 'presenting problem' where the iteration round the circular list produced the wrong answer. As Paul said, this was an 'off by one' error and relatively easily fixed.

The second problem was that the **circular_list** class interface was far too big: using public inheritance from **std::list** results in too many functions 'leaking out' into the public interface of the derived class. This problem is clearly seen with **rbegin()**/**rend()** as the circular list class needs a specific version of these functions. As Peter, Pal and Frances all pointed out, public inheritance from standard library collection classes is (almost always) a bad sign.

However, the third and biggest problem is, even if we can fix the syntax, whether or not it makes sense semantically to try and treat a circular list like a standard container. As Pal points out, there are a number of requirements for sequences listed in the C++ standard and a circular list does not comply with all of them.

The STL is a superb abstraction and has produced a large number of very useful algorithms and extension points for the C++ collection classes. However it is not a magic panacea for every possible type of data structure, and it is important to be aware of the assumptions that the STL requires for collections and iterators.

I think the best solution is to avoid the standard iterators completely, like Huw's solution does, since trying to make such circular iterators fit into the STL model is doomed to failure.

The winner of CC 71

Paul wrote a short and sweet entry that very clearly answered the initial question, but I think a little hint towards the bigger issues might have been good. When answering questions like about code like this I think there is a balance, sometimes hard to find, between just answering the specific question and pointing to bigger issues. Peter produced a detailed analysis of the problems (of which there were many!) with the source code presented, and once again demonstrated how static analysis tools can help with writing good code. I also liked Frances' approach of adding a further test to demonstrate a further problem with the original code. Huw's critique provided a very good solution to the problem with the iterators but I think the public inheritance from **std::list** needs tackling too. However, in my opinion Balog Pal's entry was the best one because he covered more of the design problems with the student's code – it was the design choice of using an STL collection to implement a circular list that led to the off by one error in the first place and his critique covered slightly more ground than Frances' did.

It was encouraging to have five entrants for this issue's critique; I hope even more people will be prepared to try the next code critique!

Code Critique 72

(Submissions to scc@accu.org by Dec 1st)

I've written a function that escapes a string of UTF-8 characters using the html entity format and I'm trying to use it with different compilers. One compiler fails to find **std::runtime_error** – don't know why – and another compiles it but produces unexpected output. Please help! I wrote a test program using the four example UTF-8 sequences from http://en.wikipedia.org/wiki/UTF-8#Description.

Here is what I want:

```
> test_escape_utf8
U+0024 \x24 = $
U+00A2 \xc2\xa2 = &#xa2;
U+20AC \xe2\x82\xac = &#x20ac;
U+024B62 \xF0\xA4\xAD\xA2 = &#x24b62;
```

Here is the unexpected output:

```
> test_escape_utf8
U+0024 \x24 = $
U+00A2 \xc2\xa2 = &#xffffffa2;
U+20AC \xe2\x82\xac = &#xfffdfac;
U+024B62 \xF0\xA4\xAD\xA2 = &#xfff20a62;
```

(See Listing 3 for test_escape_utf8.cpp, Listing 4 for escape_utf8.h and Listing 5 for escape_utf8.cpp)

Listing 3

```
#include <iostream>
#include <string>
#include "escape_utf8.h"
//U+0000 to U+007F
//Example: code point U+0024 ("Dollar sign")
//UTF-8 hex: 24
char test1[] = "U+0024 \\x24 = \x24";
//U+0080 to U+07FF
//Example: code point U+00A2 ("Cent sign")
//UTF-8 hex: C2 A2
char test2[] = "U+00A2 \\xc2\\xa2 = \xc2\xa2";
//U+0800 to U+FFFF
//Example: code point U+20AC ("Euro sign")
//UTF-8 hex: E2 82 AC
char test3[] = "U+20AC \\xe2\\x82\\xac"
  " = \xe2\x82\xac";
//U+010000 to U+10FFFF
//Example: code point U+024B62 (A CJK Unified
// Ideograph)
//UTF-8 hex: F0 A4 AD A2
char test4[] = "U+024B62 \\xF0\\xA4\\xAD\\xA2"
  " = \xF0\xA4\xAD\xA2";
int main()
{
  try
  {
    std::cout
      << escape_utf8(test1) << std::endl
      << escape_utf8(test2) << std::endl
      << escape_utf8(test3) << std::endl
      << escape_utf8(test4) << std::endl;
  }
  catch (std::exception const & ex)
  {
    std::cerr << "Exception: " << ex.what();
  }
}
```

Bookcase

The latest roundup of book reviews.

If you want to review a book, your first port of call should be the members section of the ACCU website, which contains a list of all of the books currently available. If there is something that you want to review, but can't find on there, just ask. It is possible that we can get hold of it.

After you've made your choice, email me and if the book checks out on my database, you can have it. I will instruct you from there. Remember though, if the book review is such a stinker as to be awarded the most un-glamourous 'not recommended' rating, you are entitled to another book completely free.

I must thank Blackwells and Computer Bookshop for their continued support in providing us with books.

Jez Higgins (jez@jezuk.co.uk)

Invent Your Own Computer Games with Python 2nd Edition

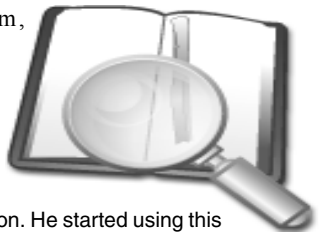
By Al Sweigart, published by Sweigart, ISBN: 978-0982106013

Reviewed by Daniel Higgins

This software design book is an easy to use beginner's guide to Python. It varies from the most simple program like just a conversation to more complicated ones such as a full game.

You don't have to have the slightest of experience of programming to use it either, you could be a total beginner and in less than a week you can easily have your own quiz on your hard drive. Then in less than a month you could be writing games such as dodger! *Invent Your Own Computer Games with Python* can also be used for children as young as ten or eleven and is an excellent book to start off with before you get to the really tough stuff!

Overall I would totally recommend this book no matter how old you are! Buy this and you can just program, program, program!



Jez Higgins: As you may have guessed Daniel is my son. He started using this book at the start of the year, shortly before his 11th birthday. He would have said he had no previous programming experience, but was thoroughly comfortable using a PC to video and audio edit, do presentations, and script levels for games. He found writing his own programs to be really quite thrilling.

The book is available online or as a PDF from http://inventwithpython.com/chapters/, although this review is of the print edition.

Pragmatic Version Control using Git

By Travis Swicegood, published by The Pragmatic Programmers, ISBN: 978-1934356159

Reviewed by Paul Grenyer

I was an early adopter of Subversion after having used CVS for a little while. I've come rather late to the Git party and I wanted a book that would give me a quick, yet

Code Critique Competition (continued)

Listing 4

```
#ifndef escape_utf8
#define escape_uft8

std::string escape_utf8(char const * utf8);

#endif
```

Listing 5

```
#include <string>
#include "escape_utf8.h"

std::string escape_utf8(char const * utf8)
{
  std::string result;
  long value;
  int multibyte(0);
  while (char const ch = *utf8++)
  {
    if (multibyte-- > 0)
    {
      if ((ch & 0xc0) != 0x80)
        throw std::runtime_error(
          "Bad multibyte continuation");
      value <<= 6;
      value += ch - 0x80;
      if (!multibyte)
      {
        result += "&#x";
        char buff[7];
        sprintf(buff, "%lx", value);
        result += buff;
        result += ';';
      }
    }
```

You can also get the current problem from the accu-general mail list (next entry is posted around the last issue's deadline) or from the ACCU website (http://www.accu.org/journals/). This particularly helps overseas members who typically get the magazine much later than members in the UK and Europe.

Listing 5 (cont'd)

```
    else if ((ch & 0xC0) == 0xc0)
    {
      value = ch & 0x1f;
      multibyte = 1;
      if (ch & 0x20)
      {
        multibyte++;
        if (ch & 0x10)
        {
          value -= 0x10;
          multibyte++;
          if (ch & 0x8)
            throw std::runtime_error(
              "Bad multibyte start");
        }
      }
    }
    else if (ch & 0x80)
      throw std::runtime_error(
        "Bad multibyte start");
    else
    {
      result += ch;
    }
  }
  return result;
}
```

View From The Chair

Hubert Matthews
chair@accu.org Members.fm

The ACCU relies on a number of hard-working volunteers to run effectively and I thank them for the considerable time and effort they put in. Like the majority of ACCU members, the committee members are busy people with lives filled with work, family and other commitments. This means that they can't always contribute in the way and to the degree that they would like or had aspired to. A case in point is that our recently elected Secretary, Alan Lenton, has had to stand down because of a major increase in his work load. We wish him luck and hope that he will be able to rejoin us in the future. In the interim, Roger Orr has kindly stepped in to replace him until the next AGM. The Secretary's position is an elected post so we need to find a suitable candidate before April. The role is not particularly onerous in terms of time but it is important, nonetheless. It involves attendance at three committee meetings per year plus the AGM, preparing agendas and writing up minutes. If you might be interested in the position please email me at chair@accu.org.

The summer is the peak time for people to renew their ACCU memberships. This year at the AGM the members voted to increase subscriptions to cover the increasing costs of magazine production and postage. Most members updated their standing orders to the new amount (£45 for individuals) – for which I am grateful – but some members have not done so yet. Over the next few months we will be contacting those who have not to remind them!

The membership form has two other fields on it and a number of members add voluntary contributions to their subscriptions for the ISDF and the hardship fund. ISDF stands for the International Standards Development Fund whose purpose is to provide support for members involved with international programming standards. Traditionally this has been for UK members of the C and C++ standards panels as well as providing email list and server facilities for these languages. However, since the ACCU has been gradually broadening its interests to encompass languages such as C# and Java it would seem logical to extend the ISDF support to these and similar languages. We would therefore be pleased to hear from any members involved in these communities who think that we might be able to help.

The other voluntary contribution is for the hardship fund. This has traditionally provided 'support to those who are unable to pay through personal financial hardship or national currency restrictions (largely those in Eastern Europe and 3rd World countries)'. Individual members' circumstances change over time and we would not wish to lose a member owing to unemployment, ill health or similar reasons so, again, the committee would be pleased to hear from anyone that thinks that either they or some other member might be suitable to be offered a year's membership.

Bookcase (continued)

solid, introduction. *Pragmatic Version Control using Git* is just such a book. I really like the Pragmatic Programmer books as they tend to be short and easy to read. They allow me to absorb a lot of information in a very short period of time.

The first thing that struck me was the brilliant simplicity of the example code. Many books on version control use Java as a language that is easily understood by most people. Even with Java you need a fair bit of code before you've got a program that does anything, even Hello, World! Swicegood uses HTML as his example code. This is perfect because everyone can understand it easily and you only need a little to do some interesting things. The HTML example is used throughout the book, in my opinion, very successfully.

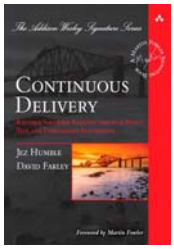
Git itself took me a little by surprise. Having a local copy of the whole repository felt a little extravagant at first and it took me a while to get my head around the idea of having to add a file every time I want to commit it, even if I've committed a previous revision. However, Swicegood explains how and why you do both of these very well and now I see the benefit of local copies of a repository and having a staging area.

Branching is key to Git and Swicegood explains it in a lot of detail. The book closes with a chapter on Subversion and CVS integration and migration with Git and a chapter on setting up a Git server. The only disappointment for me was the sparse descriptions of GUI clients. I am totally addicted to TortoiseSVN and would have liked to have seen a Git equivalent explained in some detail.

Continuous Delivery

By Jez Humble & David Farley, published by Addison Wesley, ISBN: 978-0-321-60191-9

Reviewed by Jez Higgins



The basic premise of *Continuous Delivery* is straightforward – if continuous integration is a good thing, and it is, why stop there? If we make the effort to automate our compile and test cycle so we can reliably and repeatably build our code whenever we like, then extending our automation and tooling right through into packaging, deployment, smoke/soak/integration testing brings even greater benefits.

I've spent a large part of the past two years working in exactly the areas this book covers. My colleagures and I have had some success too – our releases now take minutes rather than days. As such this book has served to reassure, but I'd would have loved to have had when we set out.

Humble and Farley are comprehensive, covering configuration management, continuous integration, data versioning, and different flavours of deployment and rollback – the end to end of the 'deployment pipeline'. You're unlikely to read from cover to cover, but the two-thirds you do read will confirm, correct, comfort, and guide.

Bookshops

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