

Portability

CPSC 315 – Programming Studio

adapted from John Keyser's 315 slides

Material from The Practice
of Programming, by Pike and Kernighan

Portability

- Ability of software to run in more than one environment
 - Run the same with differing compilers
 - Run the same on different operating systems
- “Portable” often means it is easier to modify existing code than rewrite from scratch

Why Focus on Portability?

- Some drawbacks to portability:
 - Known requirements don't specify it
 - Less efficient than less portable code
- But, requirements change
 - People will want to run successful programs in new places and ways
- Environments change
 - OS gets “upgraded” – we want the code to improve, also
- Code itself could be ported!
 - Java to C/C++
- Portability tends to reflect good programming

General Principles

- Will never have “fully” portable code, but you can improve portability
- Try to use only the intersection of standards, interfaces, environments that it *must* support
- Don't add special code to handle new situations, instead *adjust* code to fit
- Abstraction and encapsulation help

Language Issues

- Stick to Language Standards
 - Many languages aren't standardized, and no language is fully specified
 - Even such languages have very common usage patterns
- Program in the mainstream
 - Stick to language constructs that are well-understood
 - Don't use unusual language features or new language additions
 - Requires some familiarity with what "mainstream" is.

Trouble Spots in Languages

- Sizes of data types
 - int, long, pointers can vary
 - Don't assume length, beyond very well established standards
 - e.g. 8 bits in a byte

Trouble Spots in Languages

- Expressions: Order of Evaluation
 - Often not clearly specified, or implemented differently anyway

```
ptr[count] = name[++count]
```

 - count could be incremented before or after used to increment ptr
 - Avoid reliance on specific order, even when the language specifies
 - Could port code, or compiler treat differently

Trouble Spots in Languages

- "Sign" of a char
 - Could run -128 to 127, or 0 to 255
- Arithmetic and logical shifts
 - How is sign bit handled? shifted or not?
- Byte order
 - Big vs. Little endian

Trouble Spots in Languages

- Alignment of structures and class members
 - Never assume that elements of a structure occupy contiguous memory.
 - Lots of machine-specific issues
 - e.g. n-byte types must start on n-byte boundaries (bus error)
 - e.g. i could be 2, 4, or 8 bytes from start:

```
struct X {  
    char c;  
    int i;  
}
```

Dealing with Language Issues

- General Rules of Thumb:
 - Don't use side effects
 - Compute, don't assume sizes of types/objects
 - Don't (right) shift signed values
 - Make sure data type is big enough for the range of values you will store
- Try several compilers

Headers and Libraries

- Use standard libraries when available
 - Realize that these are not necessarily universal, though
 - Different implementations may have different "features"
- Careful about using lots of `#ifdefs` to catch language/environment changes
 - Easily leads to convoluted header files that are difficult to understand and maintain
- Choose widely-used and well-established standards
 - networking interfaces
 - graphics interfaces

Program Organization

- Use only features that are available in all target systems
- Avoid conditional compilation (`#ifdefs`)
 - Especially bad to mix compile-time with run-time commands
 - Makes it difficult to test on different systems, since changes actual program!

Isolation

- Localize system dependencies in different files
 - e.g. single file to capture unix vs. Windows system calls.
 - Sometimes these system files can have a life/usefulness of their own
- Hide system dependencies behind interfaces
 - Good encapsulation should be done, anyway
 - Java does this fully with virtual machine

Data Exchange

- Text tends to provide good data exchange
 - Much more portable than binary
 - Still an issue of Carriage Return vs. Carriage Return and Line Feed
- Byte Order matters
 - Big vs. Little Endian is a real issue
 - Be careful in how you rely on it
- Use a fixed byte order for data exchange
 - Write in bytes rather than larger formats

Upgrading with Portability In Mind

- If function specification changes, change the function name
 - e.g.: The sum function (for checksum to see if files were transferred correctly) in Unix has changed implementations, making it nearly useless sometimes
- Maintain compatibility with earlier programs and data
 - Provide a write function, not just a read function for earlier data formats
 - Make sure there is a way to replicate the old function
- Consider whether “improvement” is worth it in terms of portability cost
 - Don’t “upgrade” function if it will provide only limited benefit, but can potentially cause portability problems.

Internationalization

- International standards vary
- Don’t assume ASCII
 - Some character sets require thousands of characters
 - 8-bit vs. 16-bit characters
 - Unicode helps
- Careful about culture/language issues
 - Date and time format
 - Text field lengths
 - Idioms and slang
 - Icons