

Optimization: Logic Optimization

**CPSC 501: Advanced Programming Techniques
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Code Tuning Logic

Code Tuning

- Guidelines:
 - Save each version of your code using version control
 - Use the profiler to find a bottleneck
 - Tune the bottleneck, using just one technique
 - Measure the improvement
 - If none, revert to the prior version
 - Repeat until desired performance is achieved

Stop when found

Logic Techniques - Found

- Logic techniques
 - Stop testing when answer found
 - E.g.

```
boolean negFound = false;
for (int i = 0; i < input.length; i++) {
    if (input[i] < 0) {
        negFound = true;
    }
}
```

Logic Techniques – Found (cont'd)

- Is better as:

```
boolean negFound = false;
for (int i = 0; i < input.length; i++) {
    if (input[i] < 0) {
        negFound = true;
        break;
    }
}
```

Frequency

Logig Techniques - Frequency

- Order tests by frequency in switch and if-else structures
 - E.g.

```
if ((c == '+' ) || (c == '-' )) {  
    processMath(c);  
} else if ((c >= '0' ) && (c <= '9' )) {  
    processDigit(c);  
} else if ((c >= 'a' ) && (c <= 'z' )) {  
    processLetter(c);  
}
```

Logig Techniques – Frequency (cont'd)

- Since letters are more common, is better as:

```
if ((c >= 'a') && (c <= 'z')) {  
    processLetter(c);  
} else if ((c >= '0') && (c <= '9')) {  
    processDigit(c);  
} else if ((c == '+') || (c == '-')) {  
    processMath(c);  
}
```

Switch

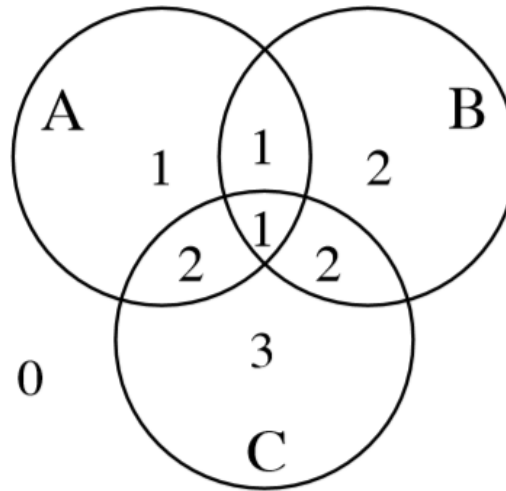
Logic Techniques - Switch

- Substitute switch statement for if-else construct, or vice-versa
 - In Java, an if-else construct can be faster than a switch ...
 - But in C switch often optimized to a lookup table
- Beware of assumptions (compiler optimizations, caching, predictive code execution mean this is variable sometimes)
- Often the longer you run modern code on CPU with simple decisions the more difference gets 'cached' or 'predictive branched' out of differences

Lookup Table

Logic Techniques – Lookup Table

- Substitute table lookups for complicated expressions
 - E.g.



Logic Techniques – Lookup Table (cont'd)

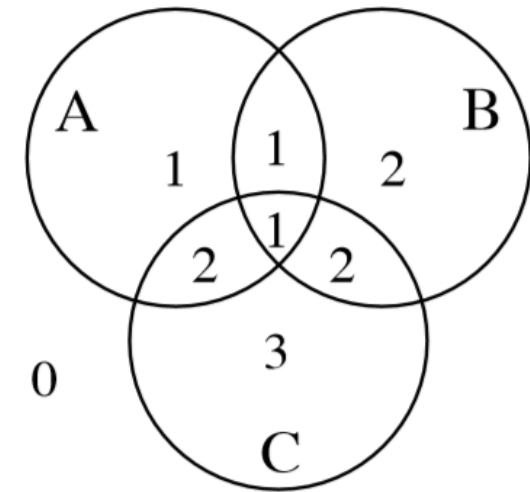
- Can be implemented using complicated logic:

```
if ((a && !c) || (a && b && c)) {  
    category = 1;  
} else if ((b && !a) || (a && c && !b)) {  
    category = 2;  
} else if (c && !a && !b) {  
    category = 3;  
} else {  
    category = 0;  
}
```

Logic Techniques – Lookup Table (cont'd)

- But is faster with a lookup table:

```
static int[][][] categoryTable = new int[2][2][2];  
static {  
    categoryTable[0][0][0] = 0;  
    categoryTable[1][0][0] = 1;  
    categoryTable[0][1][0] = 2;  
    categoryTable[0][0][1] = 3;  
    categoryTable[1][1][0] = 1;  
    categoryTable[0][1][1] = 2;  
    categoryTable[1][0][1] = 2;  
    categoryTable[1][1][1] = 1;  
}
```



```
category = categoryTable[a][b][c];
```

Lazy evaluation

Logic Techniques – Lazy Evaluation

- Use lazy evaluation
 - E.g. A 5000-entry table could be generated when the program starts
 - But if only a few entries are ever used, it may be better to compute values as needed, and then store them in the table
 - i.e. Cache them for further use

Onward to ... loop optimization.

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