

# C Programming Tools: Part 3

## Building your own Tools

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The handout and tarballs are available on CATE and at:

<http://www.doc.ic.ac.uk/~dcw/c-tools-2019/lecture3/>

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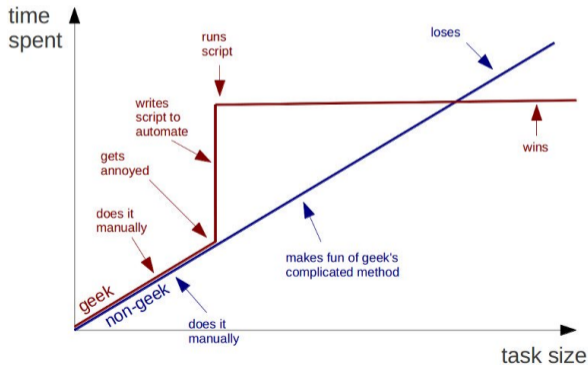
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- Let's see an example of those tips together, remembering..

### Geeks and repetitive tasks



- Suppose we find ourselves writing hundreds of repetitive “pattern instances” like this:

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int plus( int a, int b ) { return (a+b); }  
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- Specify input format (as a [little language](#)) and corresponding output:

```
INPUT:
  each line: F, Op pair
OUTPUT:
  for each F, Op pair: "int <F>( int a, int b ) { return (a <Op> b); }"
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- I wrote it in C in 15 minutes using standard library function [strtok\(\)](#) to split on comma: See [01.tiny-tool/genfuncs1.c](#).



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```

- Why not let the user change the type at any point in the input:

```
TYPE,int
plus,+
minus,-
TYPE,double
plus,+
minus,-
```

generates:

```
int   int_plus      ( int a, int b ) { return (a+b); }
int   int_minus     ( int a, int b ) { return (a-b); }
double double_plus  ( double a, double b ) { return (a+b); }
double double_minus ( double a, double b ) { return (a-b); }
```

- To implement this, change the specification to:

```
INPUT:
  each line: F, Op pair
OUTPUT:
  for each F, Op pair:
    if F=="TYPE" then T=Op
    else print "<T> <T>_<F>( <T> a, <T> b ) { return (a <Op> b); }"
```

- Make our Perl one-liner:

```
perl -nle '($f,$op)=split(/,/); if( $f eq "TYPE" ) { $t=$op; next; }
          printf "${t} %-15s( ${t} a, ${t} b ) { return (a${op}b); }\n", "${t}_${f}" < input'
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- Final thought, instead of hardcoding the output format in the printf, we could replace TYPEs with TEMPLATES in the input, for example:

```
TEMPLATE,int int_<0>( int a, int b ) { return (a<1>b); }
plus,+
minus,-
TEMPLATE,double double_<0>( double a, double b ) { return (a<1>b); }
plus,+
minus,-
```

- Here, the marker <0> means "replace this marker with the current value of the first field". Our Perl one-liner becomes more powerful but shorter:

```
perl -nle 'of=split(/,/, $_,2); if( $f[0] eq "TEMPLATE" ) { $t=$f[1]; next; }
          $_=$t; s/<(\d+)/$f[$1]/g; print' < input
```

- This is now a simple template processor.

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- The problem here is that there's a lot of repetition between the .c file and the .h file. This violates the most important Pragmatic Programmers tip: **DRY - Don't Repeat Yourself** (tip 11).

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- Let's see **proto** in action!

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- Note: Reuse can be done without OO or generics, *Make it Easy to Reuse* (PP Tip 12) - just use `void *`.

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- `C+hashes+sets` makes it easy to pretend that you're programming in Perl:-)



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- Decision time: do I abandon my brilliant idea, or **build the tool**?
- Cost/benefit analysis: a serious tool, a mini-compiler (with parser, lexical analyser, data structures, tree walking code generator): at least a week's work! Think hard!

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- ... change `types.in` later - suppose you realise that a tree node also needs to store a name (just as the leaves do). Change the type defn, rerun `datadec`. The `tree_node()` constructor now takes 3 arguments!

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- Then two `deconstructor functions` which, given a tree of the appropriate shape, breaks it into its constituent pieces:

```
extern void get_tree_leaf( tree t, string *namep );  
extern void get_tree_node( tree t, tree *lp, tree *rp );
```

- These allow you to write **tree-walking** code like this leaf-counter:

```
int nleaves( tree t )
{
    if( tree_kind(t) == tree_is_leaf )
    {
        string name; get_tree_leaf( t, &name );
        return 1;          // leaf( name ): contains 1 leaf.
    } else
    {
        tree l, r; get_tree_node( t, &l, &r );
        // node( l, r ): process l and r trees.
        return nleaves(l) + nleaves(r);
    }
}
```

- In Haskell, this'd be:

```
nleaves(leaf(name)) = 1
nleaves(node(l,r))  = nleaves(l) + nleaves(r)
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- You can read a 3-part article I wrote about how I designed `datadec` here:

<http://www.doc.ic.ac.uk/~dcw/PSD/article8/>

Remember:



(and learn Perl, it's great!)