Maak
A Build System

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  - Share common derivatives

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- Package management
  - ⋆ Packages are also dependent on each other

Problems with `make`

- Not enough abstraction:

```
prog: a.o b.o
    gcc -o prog ...
a.o: a.c
    gcc a.c
b.o: b.c
    gcc b.c
b.c: b.y
    yacc ...
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- Not enough expressive power
  - ⋆ Almost no genericity

Maak

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- Abstraction:
  - ⋆ Tools specified separately
  - ⋆ Targets specified in terms of *conceptual* dependencies; concrete dependencies and intermediates inferred automatically using tool definitions

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```
%-cc.o   : %.c $(ALLINCLUDES)
CFLAGS= $(CC_COMPILE) -c $< -o $@

%-dbg.o  : %.c $(ALLINCLUDES)
$(DBG_COMPILE) -c $< -o $@

%-gcc.o  : %.c $(ALLINCLUDES)
$(GCC_COMPILE) -c $< -o $@

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- So for every variant we have to add more rules

Example: ATerm (cont'd)

- In Maak:

```
include <stdlib.mk>;

srcs = [ <aterm.c> <list.c> ... ];

<libATerm.a> { in = srcs };
<libATerm-dbg.a> { in = srcs, cflags = "-g" };
<libATerm-gcc.a> { in = srcs, cc = "gcc" };

<primes>
  { type = "exe"
  , in = [<../test/primes.c>]
  , libs = [<libATerm-dbg.a>]
  };

"default" { type = "dummy", in = [<primes>] }
```

Example: bootstrapping GCC

```
gcc = {in = [gcc.c expr.c ...]};

gcc1 = <gcc> {cc = "/usr/bin/cc"};

gcc2 = <gcc> {cc = gcc1};

gcc3 = <gcc> {cc = gcc2};
```

Tool definitions

```
suffix ".o" "loadable";
suffix ".c" "csrc";

tool "loadable" \x ->
  { force =
      x { in = force "csrc" x.in };
      fdep x x.in;
  , build = exec "cc" [x.cflags "-c" x.in "-o" x]
  };
```

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- Very simple input language; everything is an `Expr`
  e.g., `includes` are just expressions
- Evaluation using state monad on top of I/O monad; nice: short interpreter

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  - ⋆ Impure: build the graph as a side-effect of evaluation? (Original approach)
  - ⋆ Pure/declarative, i.e., yield a graph as result of evaluation?

Pure variant

- Original approach was impure

- Making it more declarative

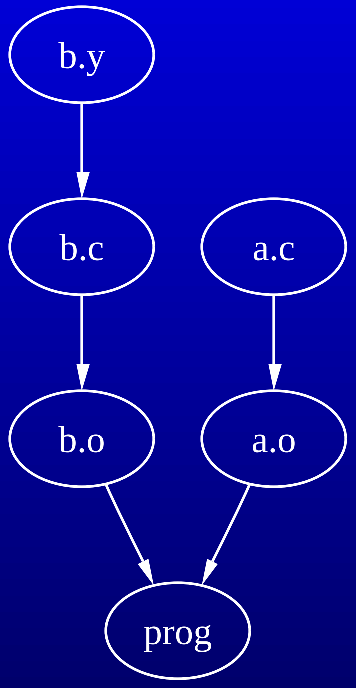
```
default = { type = "dummy", in = [primes] };

primes =
  { type = "exe", out = <primes>
  , in = [<../test/primes.c>], libs = [libATerm]
  };

libATerm = { out = <libATerm.a>, in = srcs };

libATerm-dbg = libATerm
  | { out = <libATerm-dbg.a> }
  | propagate { cflags = "-g" };
```

Wrong model



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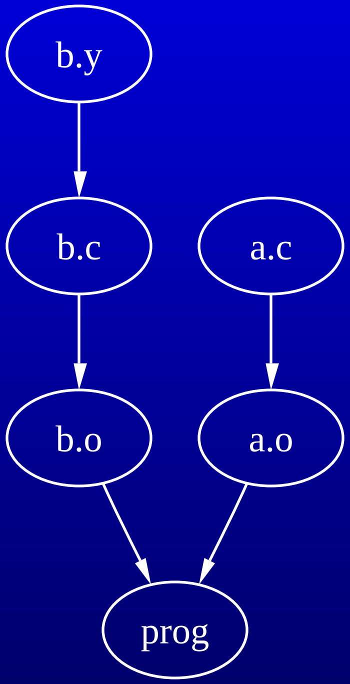
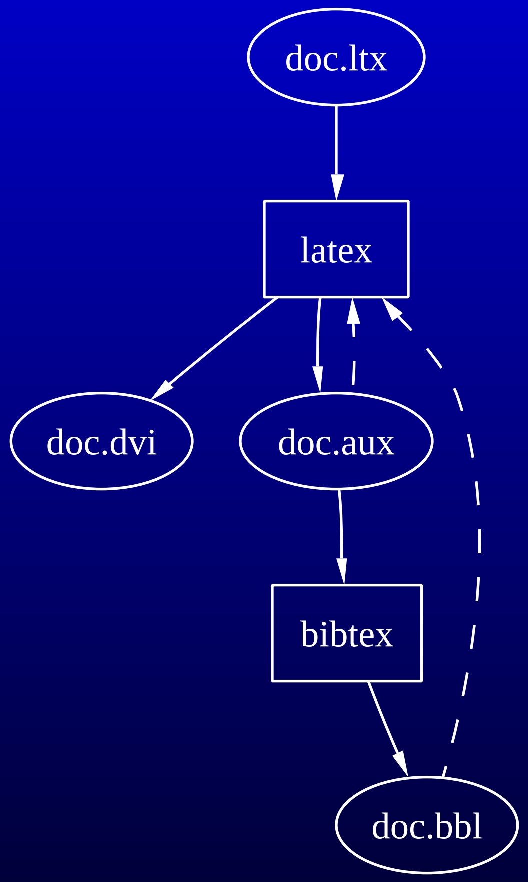


- Doesn’t work when tools have multiple outputs

Circular dependencies

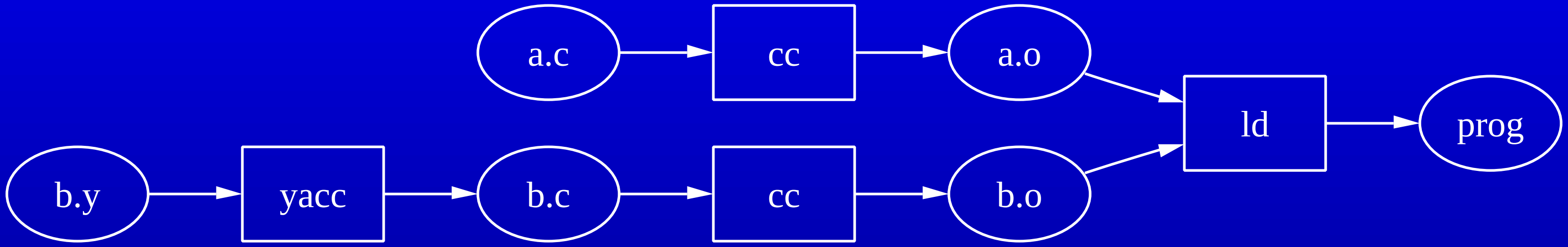
Iterate until fixpoint:



Dashed = optional dependency

Might be non-terminating!

Right model



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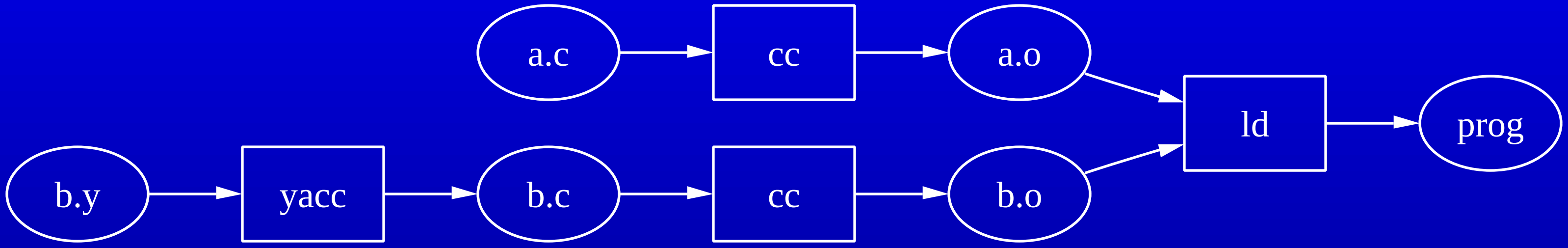

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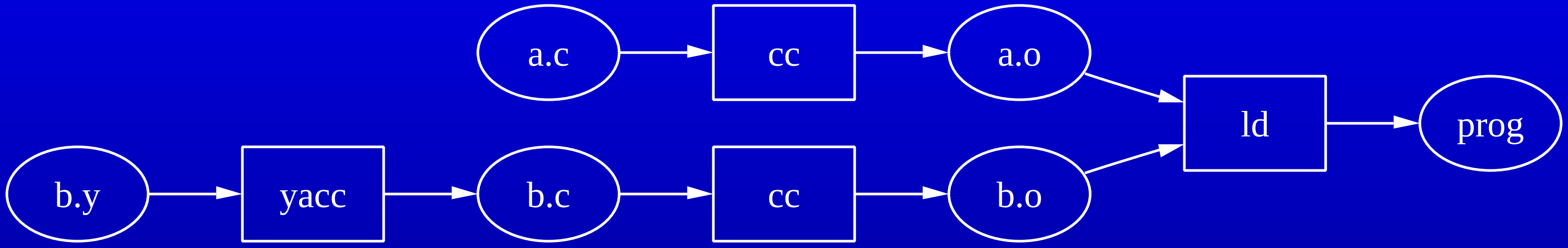

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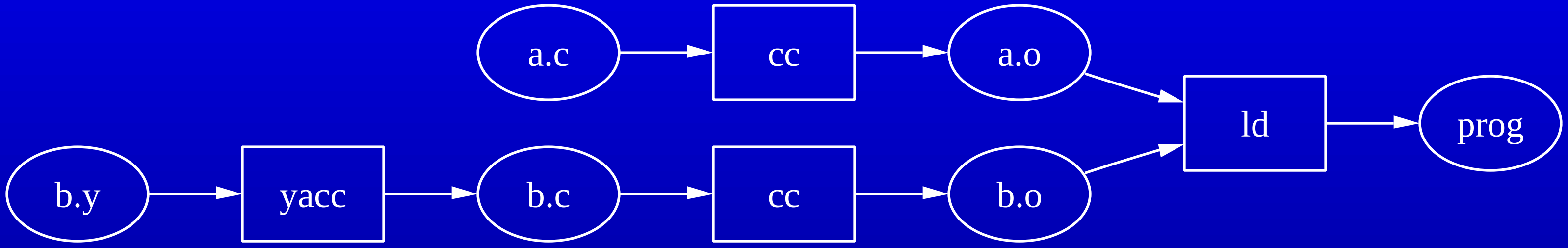

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- Targets and tool instantiations both have attributes
- How to specify?

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- Generic inferencing of dependencies: `strace`