

# PEP Scala (5)

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# Marks for CW7 (Part 1 + 2)

Raw marks (234 submissions):

- 6%: 192 students
- 5%: 16
- 4%: 7
- 3%: 2
- 2%: 6
- 1%: 1
- 0%: 9

```
def get_csv_url(url: String) : List[String] = {  
    val csv = Try(Source.fromURL(url)).getOrElse(null)  
    if (csv == null){  
        List()  
    }  
    else {  
        ....  
    }  
}
```

```
def get_csv_url(url: String) : List[String] = {  
  val csv = Try(Source.fromURL(url)).getOrElse(null)  
  if (csv == null){  
    List()  
  }  
  else {  
    ....  
  }  
}
```

---

```
def get_csv_url(url: String) : List[String] = {  
  Try(Source.fromURL(url)....).getOrElse(Nil)  
}
```

```
def get_csv_url(url: String) : List[String] = {  
  try {  
    val csvFile = Source.fromURL(url)  
    ....  
  } catch {  
    case unknown : Throwable => List()  
  }  
}
```

---

```
def get_csv_url(url: String) : List[String] = {  
  Try(Source.fromURL(url)....).getOrElse( Nil )  
}
```

# Dijkstra on Testing

“Program testing can be a very effective way to show the presence of bugs, but it is hopelessly inadequate for showing their absence.”

# Proving Programs to be Correct

**Theorem:** There are infinitely many prime numbers.

**Proof ...**

similarly

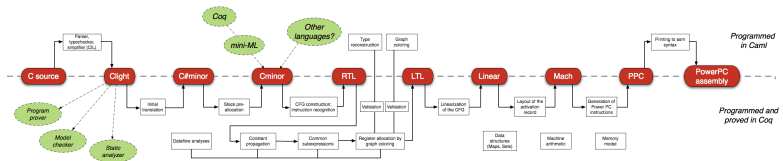
**Theorem:** The program is doing what it is supposed to be doing.

**Long, long proof ...**

This can be a gigantic proof. The only hope is to have help from the computer. 'Program' is here to be understood to be quite general (compiler, OS, ...).

# Can This Be Done?

- in 2011, verification of a small C-compiler (CompCert)
  - “if my input program has a certain behaviour, then the compiled machine code has the same behaviour”
  - is as good as gcc -O1, but much, much less buggy





# Fuzzy Testing C-Compilers

- tested GCC, LLVM and others by randomly generating C-programs
- found more than 300 bugs in GCC and also many in LLVM (some of them highest-level critical)
- about CompCert:

“The striking thing about our CompCert results is that the middle-end bugs we found in all other compilers are absent. As of early 2011, the under-development version of CompCert is the only compiler we have tested for which Csmith cannot find wrong-code errors. This is not for lack of trying: we have devoted about six CPU-years to the task.”

# seL4 / Isabelle

- verified a microkernel operating system ( $\approx 8000$  lines of C code)
- US DoD has competitions to hack into drones; they found that the isolation guarantees of seL4 hold up
- CompCert and seL4 sell their code

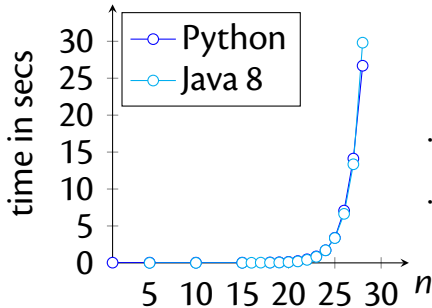
# seL4 / Isabelle

- verified a microkernel (written in C code)
- US DoD has committed to using it (but they found that the is
- CompCert and seL4 sell their code



# CW9 : Regexes

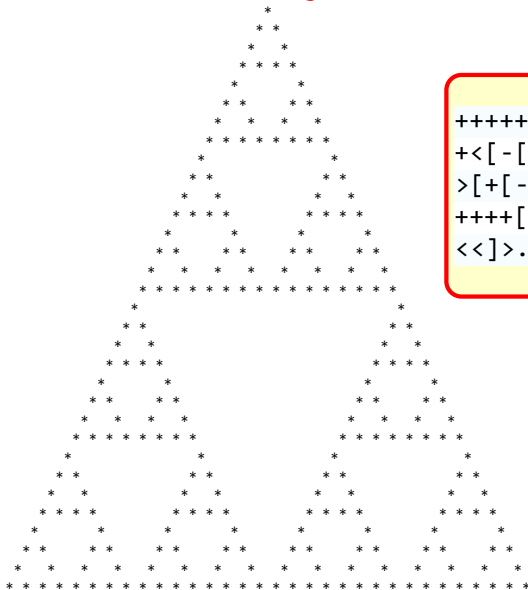
Graphs:  $(a^*)^*b$  and strings  $\underbrace{a \dots a}_n$



# Where to go on from here?

- Martin Odersky (EPFL)...he is currently throwing out everything and starts again with the dotty compiler for Scala
- Elm (<http://elm-lang.org>)...web applications with style
- Haskell, Ocaml, Standard ML, Scheme, ...

# Questions?



```
+++++++ [ >+>++++< <- ]>+>>
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> [ + [ - ]+>+>> ]>>-<< ]< [ < ]>>+
++++ [ <<++++>> ]>- ]+<<+> . [ - ]
<< ]> . >+ [ >> ]>+ ]
```

# Marks for CW6 (Part 1 + 2)

Raw marks:

- 6%: 154 students
- 5%: 66
- 4%: 18
- 3%: 13
- 2%: 2
- 1%: 1
- 0%: 21