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- No style: unstructured things like assembly language, where there is no support for structuring

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But the point is there are many *styles* of programming

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When projects get large you cannot do this

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So styles are invented to direct the way you write code so to make large systems written by many programmers possible

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And make writing correct programs easier

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Programmers make mistakes. So how can a programming language help the programmer to make fewer mistakes?

Styles

> *Debugging is twice as hard as writing the code in the first place. Therefore, if you write the code as cleverly as possible, you are, by definition, not smart enough to debug it*

Brian Kernighan

> *The errors you can spot easily are not the ones you need to worry about*

Anon

> *Programmers should be lazy and stupid*

Me

Styles

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Unfortunately, there is no single programming language that does everything well

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In 2010, the iPhone 4 had problems with reception. Apple’s response was essentially “you are holding it incorrectly”

Styles

If you have a hammer, everything looks like a nail
If you have Java, everything looks object oriented

Anonymous

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Both Java and Python (and many others) have OO *and* procedural aspects

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Java provides a general mechanism (that you don’t see) for method lookup that has to work for all kinds of situations

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For a heavily numerical application, such as a weather forecasting, objects would be just a hindrance to coding

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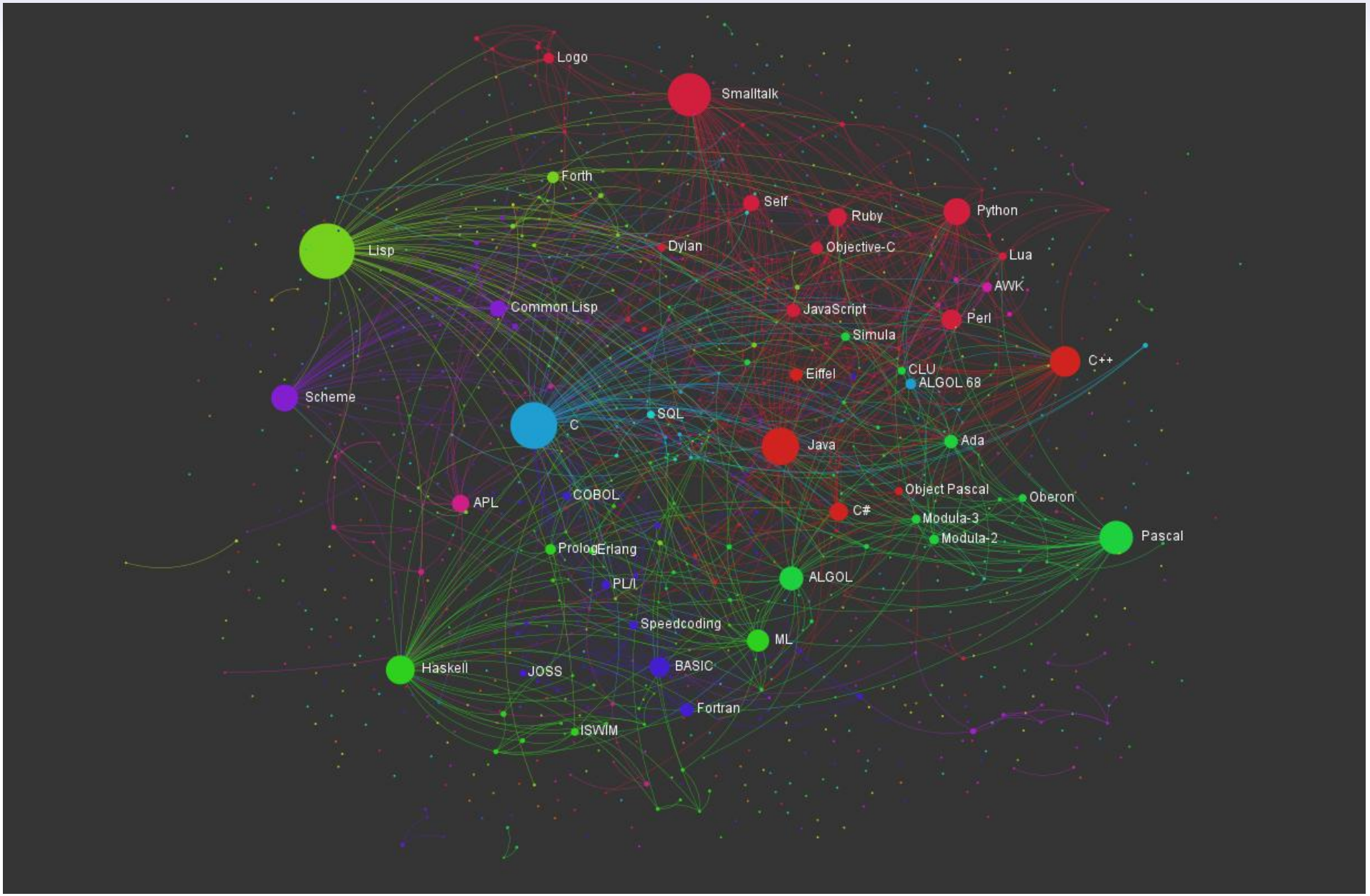
Others problems are near impossible to program regardless of style

Part of being a Computer Scientist is knowing these styles and knowing which languages support them

And then picking a style for a problem, then a language that supports that style



Programming Languages Influence Network

Language Families

From
`https://exploringdata.github.io/vis/programming-languages-influence-network/`

an interactive, zoomable map of languages

Language Families

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And almost always unnecessary

Language Families

Most “new” languages are modest variants on existing languages, often emphasising some features of interest to the language designer

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Thus languages tend to fall into *families*, where members of the same family have many features in common

Language Families

You may have already seen (or will soon see)

- C: procedural
- Haskell, Lisp: functional
- Prolog, ASP: logic
- Python: procedural and scripting
- Java: object oriented
- etc.

Families are not clearly separated: they are fuzzy at the edges

Language Families

Feet

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- Python: You try to shoot yourself in the foot but you just keep hitting the whitespace between your toes

Language Families

Feet

- Java: You locate the Gun class, but discover that the Bullet class is abstract, so you extend it and write the missing part of the implementation. Then you implement the ShootAble interface for your foot, and recompile the Foot class. The interface lets the bullet call the doDamage method on the Foot, so the Foot can damage itself in the most effective way. Now you run the program, and call the doShoot method on the instance of the Gun class. First the Gun creates an instance of Bullet, which calls the doFire method on the Gun. The Gun calls the hit(Bullet) method on the Foot, and the instance of Bullet is passed to the Foot. But this causes an IllegalHitByBullet exception to be thrown, and you die

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Some are used widely, but you don't realise (Cobol, Fortran)

Some are not used much at all, but have been important influences on other languages (APL, Snobol, Algol)

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- Cobol: USEing a COLT 45 HANDGUN, AIM gun at LEG.FOOT, THEN place ARM.HAND.FINGER on HANDGUN.TRIGGER and SQUEEZE. THEN return HANDGUN to HOLSTER. CHECK whether shoelace needs to be retied

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- APL: You hear a gunshot and there's a hole in your foot, but you don't remember enough linear algebra to understand what happened.
- Snobol: If you succeed, shoot yourself in the left foot. If you fail, shoot yourself in the right foot

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Continuing Exercise go and read further around these (and other) languages to discover why they have these descriptions

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Exercise for advanced students: make up jokes for the missing ones and funnier versions for existing ones

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How do we choose which to use?

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Sometimes we only have a restricted choice

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We need to able to

- identify and assess characteristics of a given language
- recognise similarities between languages
- recognise if a feature is unique to a language
- take concepts from one language to another (learn one, learn 'em all)

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Avoid re-implementation and old mistakes: wise people learn from the mistakes of others

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But it is important to remember that families are **not exclusive**, a language can sit comfortably in more than one family

Aside

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There are many place in CS where people use different words for the same things; or the same word for different things. Be aware of such variations!