Large(r) software systems

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How familiar is this?

Getting more complex

Even for single person projects, that approach doesn't stay satisfactory for long. Why?

- ▶ Sheer size. Once you get beyond 10, 20 or so classes, it's a pain to have everything in one directory (and one namespace). You'll *think* about some classes as being more closely related than others: it helps to make that visible.

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- ▶ **Packaging your own software.** You'll probably need to distribute your own software as something more manageable than a bunch of .class files, e.g., as a .jar

What you need at this stage ($* \rightarrow$ more later)

You'll make some use of Java *packages*$*$, and corresponding directory structure. Most tools will come with your IDE:

Essential tools:

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Nice to have tools (non-exhaustive):

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Examples of possibly useful tools:

- ► Documentation generator (e.g. Javadoc) if you have programmer users*
- ► Bug tracker (e.g. JIRA,Bugzilla,Mantis) if you have many users
- ► Wiki, mailing lists, depending on community

Beyond single-person projects

What changes when you're working in a team, say up to about 10 people? Actually not so much – it isn't that you need new stuff, so much as that you need it *more*.

E.g., on your own, using version control∗ and a good clear coding style∗ are good habits. In a team, chaos results if you don't.

Less obvious kinds of dependency become important. E.g.,

- ▶ in a one-person project, the version of Java you're using is whatever's on your machine.
- ▶ Once other people are involved, you need them to have the same version.
- ▶ So it's good to have a record, along with the source files, of what version of Java they are written for, and a tool that can arrange for the right version to be used.
- ▶ That's one of the many jobs done by a project file in an IDE. e.g., *.project* in Eclipse.

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- ▶ Build file: is there a file called build.xml or pom.xml? This gives instructions to the *ant* or *maven* build program∗ . Try `ant build` or `mvn` at the command line. ...

Even bigger projects

Why would we ever need teams of > 10 people, and more complex software than 10 people can build?

First: often, it's arguable that we don't. Agile development∗ is founded on the idea of using a small, colocated team and biting off the most important requirements first. Martin Fowler's answer to "How would you manage a distributed team of 100 software developers?" was "I wouldn't"...

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Some projects just cannot be done with only 10 people; some need $> 1MLoC$ (Million Lines of Code).

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These overlap.

Common themes: documentation becomes important, and can't be replaced by informal communications, however good; and need to make the development process∗ explicit.

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Recommended reading: blog on problems in the FADEC code.

http://www.computerweekly.com/blogs/tony_collins/2010/02/eds-software-report-that-went.html

Socio-technical systems

Term used of a system that functions as part of society or an organisation.

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But is that really true of any system now?

Sociologists who study socio-technical systems would say all but trivial software is part of a larger social system... c.f. Facebook.

Ultra-large scale systems (ULS)

We already mentioned "project needs many complex interfaces" as one reason why systems get large and complex.

The more we depend on software the more interfaces we need. Ultimately "the system" may not be easy – or useful – to identify.

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Term coined around 2006 by Carnegie-Mellon's Software Engineering Institute in response to US Army's query: "Given the issues with today's software engineering, how can we build the systems of the future that are likely to have billions of lines of code?"

Question was unsurprisingly not answered! But SEI pointed out that, e.g., must design *mechanisms*, as can't predict behaviour in full detail; hardware and software failures will be normal and must be managed.

Jargon, sure – but indicative of a long-term trend.

Suggested Reading

- Blog on Chinook FADEC.
- CMU's page on Ultra Large Scale systems.

Pick your open-source package for the coursework!