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# Introduction to Software Engineering

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# What is Software Engineering?

- Many different definitions!
- Wikipedia:
  - “Software engineering is the application of engineering to the design, development, implementation, testing and maintenance of software in a systematic method.”
- Alternatively:
  - “The use of processes and their associated tools to improve the quality of software”
- One of the first conferences organised by NATO in 1968



# Ariane 5

- Inertial reference system shut down due to integer overflow causing an exception
- System attempted to compensate for the diagnostic pattern caused by the exception
- Code was an unnecessary hold-over from Ariane 4!



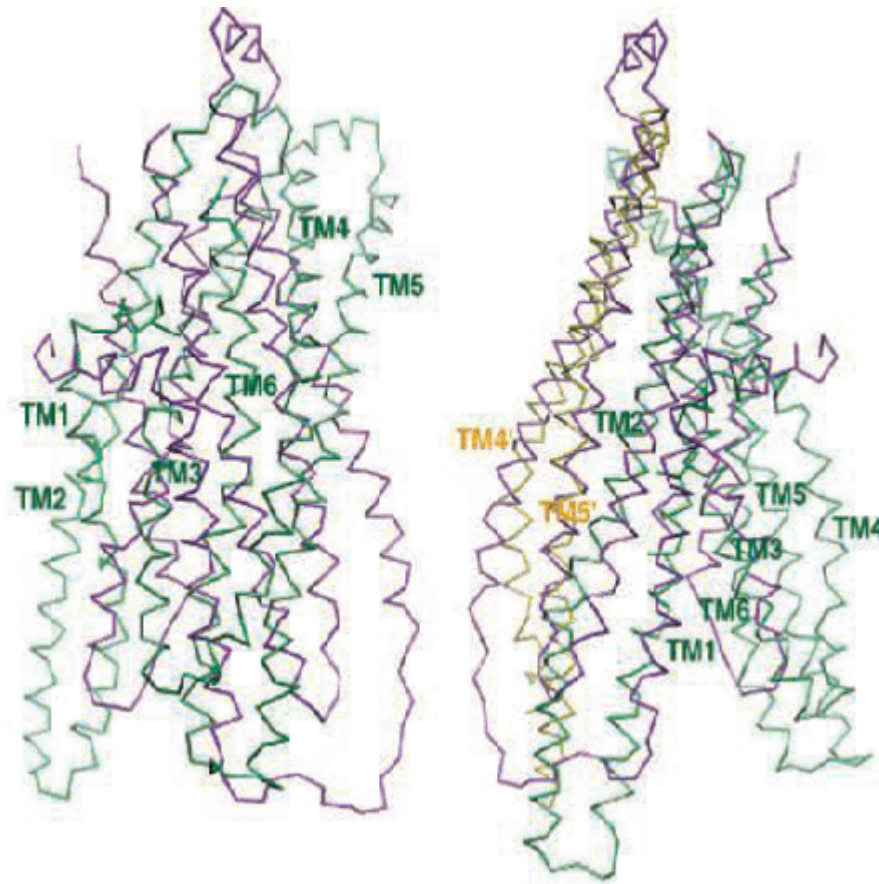
CREDIT: ESA



# Protein Structure

- “A Scientist's Nightmare: Software Problem Leads to Five Retractions”
  - “Due to an error caused by a homemade data-analysis program, on page [1875](#), Geoffrey Chang and his colleagues retract three *Science* papers and report that two papers in other journals also contain erroneous structures.”
- Science 22 Dec 2006: Vol. 314, Issue 5807





CREDIT: R. J. P. DAWSON AND K. P. LOCHER,  
NATURE 443, 180 (2006)



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# Genomics

- “Gene name errors are widespread in the scientific literature”
  - “The spreadsheet software Microsoft Excel, when used with default settings, is known to convert gene names to dates and floating-point numbers. A programmatic scan of leading genomics journals reveals that approximately one-fifth of papers with supplementary Excel gene lists contain erroneous gene name conversions.”
- Genome Biology 2016 17:177



# What can we do?

- Software engineering is important at every stage of the software lifecycle
  - Everything from requirements gathering and design through to implementation and deployment
- Processes, tools and techniques have been developed for each of these stages
  - Today we focus on the implementation
- By using these approaches it is possible to reduce the number of bugs and increase the quality of the code
  - Must be pragmatic, if it is too difficult for you or other developers then it won't work!



# Implementation Topics

- Pair programming
- Code review
- Continuous integration
- Testing
  - Unit
  - Integration
  - Performance
  - Regression
  - System





# Implementation Topics

- Revision control
- Analysis
  - Static
  - Dynamic
- Profiling
- Debugging
- Coding standards



# Summary

- Good software engineering should make your software more maintainable, reliable and easier to understand and use
- Huge amounts of effort are spent on developing tools and techniques for writing good software
  - Make use of it!
- The CCP-WSI repository has some tools and processes already in place to promote good Software Engineering

