MSc in Advanced Computer Science

The University of Manchester

Software Security and Automated Reasoning (SS & AR)

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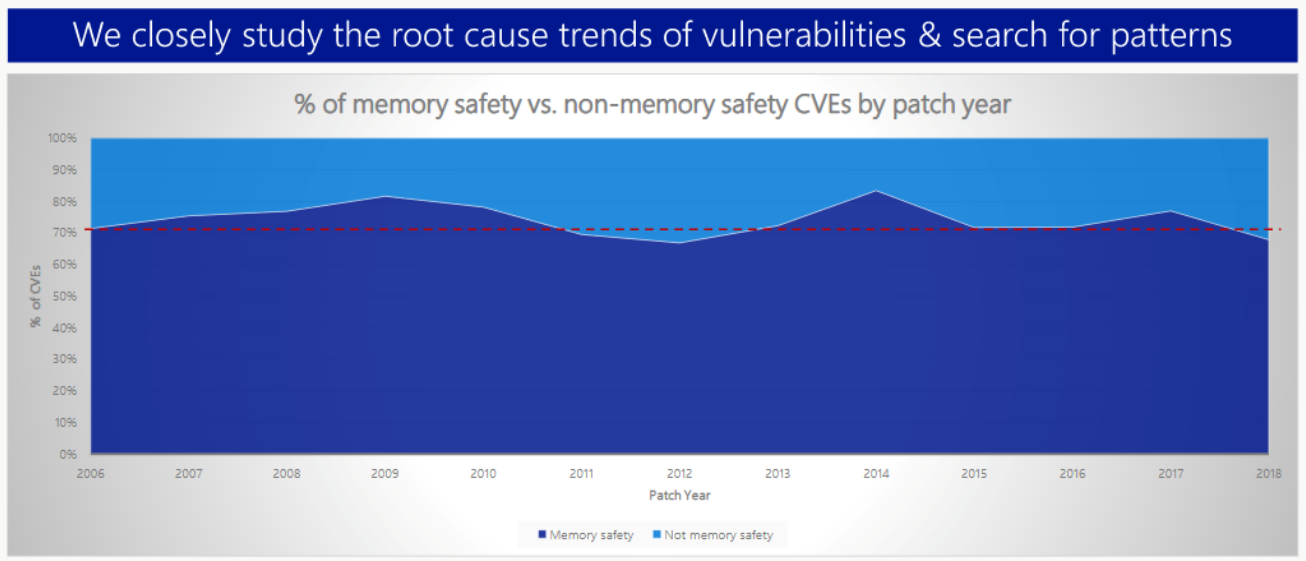
70 percent of all security bugs are memory safety issues

Microsoft

- *"The majority of vulnerabilities are caused by developers inadvertently inserting memory corruption bugs into their C and C++ code. As Microsoft increases its code base and uses more Open Source Software in its code, this problem isn't getting better, it's getting worse (2019)."*



https://www.zdnet.com/article/microsoft-70-percent-of-all-security-bugs-are-memory-safety-issues/

Security Vulnerabilities

```
int getPassword() {
  char buf[4];
  gets(buf);
  return strcmp(buf, ”SMT”);
}
```

```
void main(){
  int x=getPassword();
  if(x){
    printf(“Access Denied\n”);
    exit(0);
  }
  printf(“Access Granted\n”);
}
```

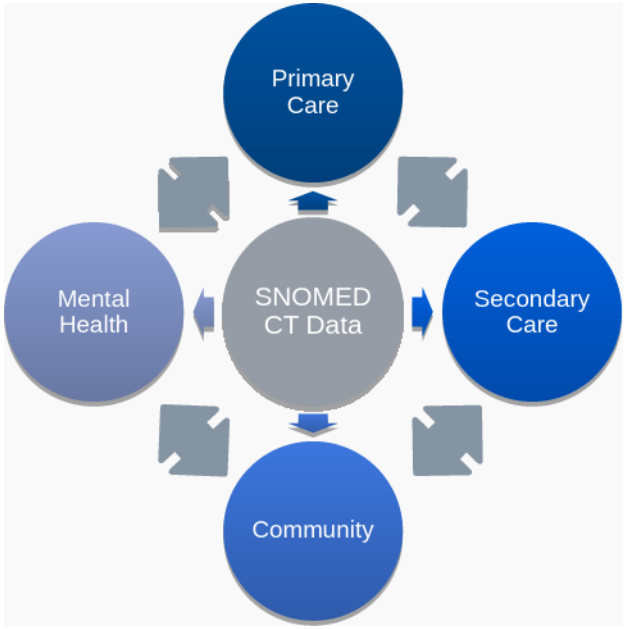
- What happens if the user enters “SMT”?
- On a Linux x64 platform running GCC 4.8.2, an input consisting of 24 arbitrary characters followed by *]*, <*ctrl-f*>, and @, will bypass the “Access Denied” message
- A longer input will run over into other parts of the **computer memory**

Exciting research projects concerning SS & AR:

EnnCore SCorCH ELEGANT

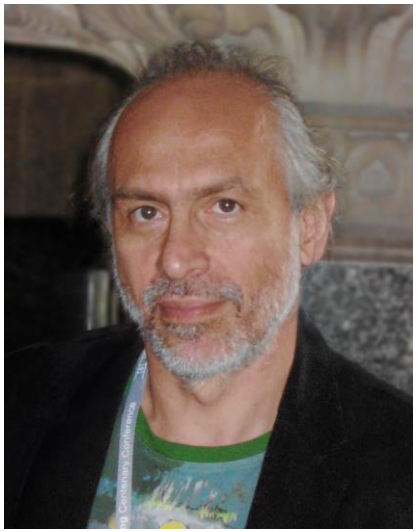
Automated Reasoning

- It is fundamental to CS and AI, and provides powerful tools for
  - ***Ensuring correct functioning of complex systems*** (software, security protocols, hardware, product configuration, ...)
  - Microsoft, Intel, NASA, Mercedes, Toyota, Airbus
  - ***AI in Health:*** underpins medical terminological services to enable consistent data capture in EHRs, data sharing, smart data analysis across the NHS
  - Researchers at Manchester have teamed up with SNOMED Intl to develop bespoke approach for content extraction and sharing in the medical ontology SNOMED CT
  - ***Many other difficult problems:*** professional sports scheduling, planning, optimisation, ...



Automated Reasoning

- Is a truly international subject area that has attracted outstanding scholars
- Prof Wu Wenjun (吴文俊), Herbrand Award Winner 1997
- Prof Andre Voronkov, Herbrand Award Winner 2015



Software Security and Automated Reasoning

Our theme will embrace various techniques and tools that exist to **prevent and detect software flaws**, which are typically hard to be manually found, including **modelling, code reviews, fuzzing, static and dynamic code analyses, code tainting, and automated reasoning**

COMP60332 - Automated Reasoning & Verification

- What will you learn?
  - Basics: modelling of knowledge, propositional/first-order logic, …
  - Approaches underpinning modern AR&V systems
  - Techniques to achieve efficiency: backjumping, orderings, redundancy elimination...
  - Solving a variety of reasoning problems, incl. verification and security protocol analysis
- You will understand some of the most powerful and efficient automated reasoning methods, and how and why they work

COMP63342 - Software Security

- What will you learn?
  - Approaches to formally build verified **trustworthy software systems** to ensure **confidentiality, integrity and availability**
  - Understand **risk assessment** to guide software developers and provide rules for secure coding to avoid **exploitable vulnerabilities**
  - Detection of software vulnerabilities using **static and dynamic analysis**
  - Use verification techniques to reason about the **AI system's safety and security**

Assessment (COMP60332 and COMP63342)

- How will you learn?
  - Lectures, workshops, tutorials, labs/practicals
- COMP63342:
  - 70% Coursework
    - Lab exercises = 40%
    - Blackboard Quizes = 10%
    - Seminars = 20%
  - 30% Exam
    - Format: 2 hours, 3 questions, all the material
- COMP60332:
  - Weekly coursework 5 x 10%
  - Written exam 50%

Some advice on choosing themes

- The **Software Security & Automated Reasoning** theme can be combined with any other theme
- Has no prerequisites, no pre/co-requisite to any theme
- It goes well with all themes
  - *Cyber Security*, *Software Engineering*
  - *Data on the Web*
  - *Data Engineering & Systems Governance*, *Learning from Data*
- Can be chosen in all pathways; core in the Computer Security pathway

Questions? Please email:

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