PA193 Secure coding principles and practices

Overview of the subject

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Kamil Dudka, Mirek Jaroš, Martin Ukrop, Jan Masarik

CROCS
Centre for Research on Cryptography and Security

PA193 Secure coding principles and practices

- Secure coding
  - How to write code in a more secure way
  - So that the program is harder to be attacked/exploited
  - Selected basic building blocks of security applications
- 2/2/2
  - Lecture: 2 hours weekly
  - Seminar: 2 hours weekly
  - Homework: about 6-? hours/each
  - Project: about 30-40 hours/person

People

- Main contact: Petr Švenda (CRoCS@FI MU)
  - Office hours: Tuesday 13:00-13:50, A406


svenda@fi.muni.cz,  @rngsec


https://keybase.io/petrs


https://crocs.fi.muni.cz/people/svenda

- Other lectures and seminars
  - Milan Patnaik (DRDO) Marek Sýs (FI), Jan Masrik (Kiwi) Kamil Dudka (RedHat), Mirek Jaroš (RedHat), Martin Ukrop (FI)

Previous knowledge requirements

- Basic knowledge of (applied) cryptography and IT security
  - symmetric vs. asymmetric cryptography, PKI
  - block vs. stream ciphers and usage modes
  - hash functions
  - random vs. pseudorandom numbers
  - basic cryptographic algorithms (AES, DES, RSA, EC, DH)
  - risk analysis
- Basic knowledge in formal languages and compilers
- User-level experience with Windows and Linux OS
- **Practical experience with C/C++/Java language**

Organization

- Lectures + seminars + assignments + project + exam
- Assignments
  - 10 homework assignments
  - **Individual work of each student**
  - Lab A403 available to students (except teaching hours)
- Project
  - **Team work** (2-3 members)
  - Details next week (cryptowallet derivation, CI, fuzzing…)
- Exam
  - Written exam, open questions, pencil-only

Grading

- Credits
  - 2+2+2 credits, plus 2 for the final exams
- Points [Notice minimal number of points required!]
  - Homework (50) – [minimum 25 required]
  - Project (20) – [minimum 10 required]
  - Written exam (50) – [minimum 25 limit]
  - Occasional bonuses ☺
  - TLDR: must get at least half points from each area
- Grading 120 (max)
  - A ≥ 110
  - B ≥ 100
  - C ≥ 90
  - D ≥ 80
  - E ≥ 65
  - F < 65

Attendance

- Lectures
  - Attendance not obligatory, but highly recommended
- Seminars
  - Attendance **obligatory**
  - Absences must be excused at the department of study affairs
  - 2 absences are OK (even without excuse)
- Assignments and projects
  - Done during student free time (e.g. at the dormitory)
  - Access to network lab and CRoCS lab is possible

Discussion forum in Information System

- Discussion forum in Information System (IS)
  - https://is.muni.cz/auth/cd/1433/podzim2019/PA193/
- Mainly for discussion among the students
  - Not observed by stuff all the time!
  - Write us email if necessary
- What to ask?
  - OK to ask about ambiguities in assignment
  - NOT OK to ask for the solution
  - NOT OK to post your own code and ask what is wrong

Plagiarism

- Homeworks
  - Must be worked out independently by each student
- Projects
  - Must be worked out by a team of 3 students
  - Every team member must show his/her contribution
- Plagiarism, cut&paste, etc. is not tolerated
  - Plagiarism is use of somebody else words/programs or ideas without proper citation
  - Automatic tools used to recognize plagiarism
  - If plagiarism is detected student is assigned -7 points
  - More serious cases handled by the Disciplinary committee

Reuse of existing code

- Code reuse is generally great thing, but..
- NOT in homework or assignments!
- It is NOTOK:
  - Take any code from web when you should create code completely on your own (project - parser)
  - Share code of your solution with others (homework)

18/11/2015 17:06:32 4,716 bytes C,C++,C#,ObjC Source ANSI PC

```c
#include "LDSSecurityObject.h"
#include <dirent.h>
#include <openssl/sha.h>
int main(void)
{
    LDSSecurityObject_t *lds;
    lds = (LDSSecurityObject_t*)calloc(1, sizeof *lds);
        DIR *dir;
        FILE *fp;
        char dirname[100],dirname1[100];
        char filenames[100][100];
        char correctna[100];
        int countfile;
        int count,j,i,flag=0
        int foundinde
        struct dirent *ent;
    if(!lds) exit(1);

    FILE *f=fopen("Sample-data/lds.bin","rb");
    if(!f) exit(1);
    unsigned char buffer[10000];
    int bufflen,size;
        char *input;
        unsigned char *hashvalue;
    bufflen=fread(buffer,1,10000,f);
    fclose(f);

        printf("Input the name of directory  (example Sample-data)");
        scanf("%s",dirname);

         strcpy(dirname1,dirname);
         if ((dir = opendir (dirname)) != NULL)
         {
            while ((ent = readdir (dir)) != NULL)
            {
                strcpy(filenames[countfiles],ent->d_name);
                        //printf ("%s\n", ent->d_name);
                        //printf ("%s\n", filenames[countfiles]);
                countfiles++;
        }
                closedir (dir);
          }
         else
          {

          /* could not open directory */
      perror ("");
          }
```

18/11/2015 17:06:32 4,221 bytes C,C++,C#,ObjC Source ANSI PC

```c
#include "LDSSecurityObject.h"
#include <dirent.h>
#include <openssl/sha.h>
int main(void)
{
    LDSSecurityObject_t *lds;
    lds = (LDSSecurityObject_t*)calloc(1, sizeof *lds);
        DIR *dir;
        FILE *fp;
        char Directory[100],Directory1[100];
        char in_file_name[100][100];
        char corrct_names[17][100];
        int no_of_files =0,i;
        int cnt,j,cmp,flag=0;

        struct dirent *ent;
    if(!lds) exit(1);

    FILE *f=fopen("Sample-data/lds.bin","rb");
    if(!f) exit(1);
    unsigned char buffer[10000];
    int bufflen,size;
        char *input;
        unsigned char *hashvalue;
    bufflen=fread(buffer,1,10000,f);
    fclose(f);

        printf("Enter the name of directory  (example Sample-data) to be verified :");
        scanf("%s",Directory);

         strcpy(Directory1,Directory);
         if ((dir = opendir (Directory)) != NULL)
         {
            while ((ent = readdir (dir)) != NULL)
            {
                strcpy(in_file_name[no_of_files],ent->d_name);

                 no_of_files++;
        }
                closedir(dir);
          }
         else
          {

          /*Directory opening error*/
      perror ("");
          }
```


1: 1 Compiler Directive

1: 1 Compiler Directive

12/11/2015 11:27:15 4,135 bytes C,C++,C#,ObjC Source ANSI PC

```
int bitrates[] = {
    BITRATEFREE, BITRATEFREE, BITRATEFREE, BITRATEFREE, BITRATEFREE,
    32,  32,  32,  32,    8,
    64,  48,  40,  48,   16,
    96,  56,  48,  56,  24,
    128,  64,  56,  64,  32,
    160,  80,  64,  80,  40,
    192,  96,  80,  96,  48,
    224, 112,  96, 112,  56,
    256, 128, 112, 128,  64,
    288, 160, 128, 144,  80,
    320, 192, 160, 160,  96,
    352, 224, 192, 176, 112,
    384, 256, 224, 192, 128
    416, 320, 256, 224, 14
    448, 384, 320, 256, 1
    BITRATEBAD, BITRATEBAD,  BITRATEBAD, BITRATEBAD, BITRATEBAD
};

typedef struct{
```

18/11/2015 16:40:53 11,086 bytes C,C++,C#,ObjC Source ANSI UNIX

```
int bitrates[] = {
    BITRATEFREE, BITRATEFREE, BITRATEFREE, BITRATEFREE, BITRATEFREE,
    32,  32,  32,  32,    8,
    64,  48,  40,  48,   16,
    96,  56,  48,  56,  24,
    128,  64,  56,  64,  32,
    160,  80,  64,  80,  40,
    192,  96,  80,  96,  48,
    224, 112,  96, 112,  56,
    256, 128, 112, 128,  64,
    288, 160, 128, 144,  80,
    320, 192, 160, 160,  96,
    352, 224, 192, 176, 112,
    384, 256, 224, 192, 128,
    416, 320, 256, 224, 144,
    448, 384, 320, 256, 160,
    BITRATEBAD, BITRATEBAD, BITRATEBAD, BITRATEBAD, BITRATEBAD
};

typedef struct{
    //// unsigned    framesync   :12;    //Frame synchronizer
```

12/11/2015 11:27:15 4,135 bytes C,C++,C#,ObjC Source ANSI PC

```
int readMP3header(FILE *f, MP3HEADER *h){


    MP3ID3TAG2 tag;

    //push file point to the beginning


    rewind(f);
    fread(&tag, 1, sizeof(MP3ID3TAG2), f);

    //tag id3v2 are located at the beginning of file, id3v1 at the end
    if(tag.tagid[0]=='I' && tag.tagid[1]=='D' && tag.tagid[2]=='3'){//is

        fseek(f, unpacktagsize(tag), SEEK_CUR);



    }else{//isn't tag id3v2 - go back
        rewind(f);
    }

    //I'm currently not interested in the final state of the file pointe
```

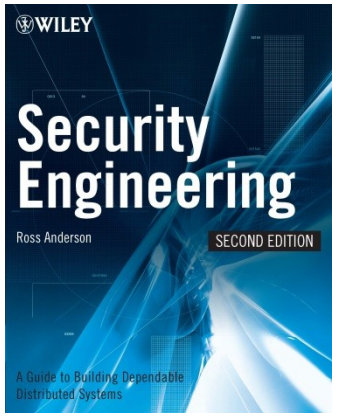
11/20 16:40:53 11,086 bytes C,C++,C#,ObjC Source ANSI UNIX

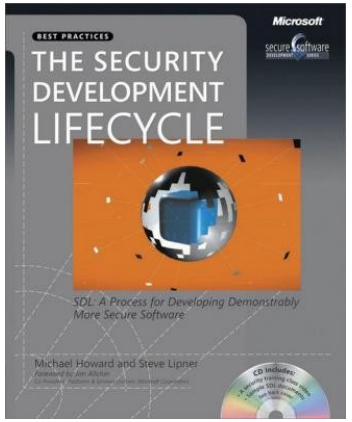
```
t Read 3He er ILE *f, MP3HEADER *h, unsigned int StartFlag, uint16_t fra
    uns  head[4] ;
    int cont ;
    MP3ID3TAG2 ag
    int lc = 0;

     if ( StartFlag == 1 )
      {
        rewind(f);      /////  set file pointe to be, ni  o  ile
        fread(&tag, 1, sizeof(MP3ID3TAG2), f);

        //// Check for the tag id3v2 is preasent at the beginning of file,
        if(tag.tagid[0]=='I' && tag.tagid[1]=='D' && tag.tagid[2]=='3')
           { ////  if tag id3v2 is present then jump to end of tag
            fseek(f, unpacktagsize(tag), SEEK_CUR);

            printf("\nFile Has Id3Tag2 Present At Begining");
           }
        else{   //// if tag idv3 isn't present then go back to begining of fi
            rewind(f);
            }
      }
```

Course resources

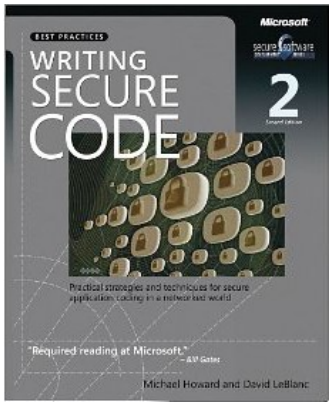
- Lectures (PDF) available in IS
  - IS = Information System of the Masaryk University
  - https://is.muni.cz/auth/el/1433/podzim2019/PA193/
- Homeworks/assignments available in IS
  - Submissions also done via IS (Homework vaults)
- Additional tutorials/papers/materials from time to time will also be provided in IS
  - To better understand the issues discussed
- Recommended literatures
  - To learn more …

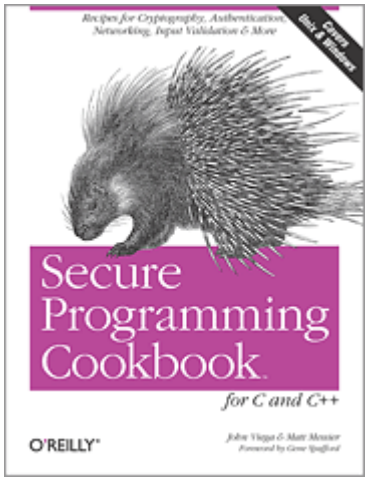
Recommended literature





- Ross Anderson - Security engineering, Wiley
- Michael Howard, Steve Lipner - Secure Development Lifecycle, MS Press
- John Viega, Matt Messier - Secure programming cookbook, O'Reilly
- Michael Howard - Writing secure code, MS Press





Lectures and content

- 16. 9. Intro, Language level vulnerabilities: Buffer overflow, type overflow, strings (PS)
- 23. 9. Security testing: blackbox vs. whitebox testing, static analysis (PS)
- 30. 9. Security testing: dynamic analysis, fuzzing (PS)
- 7. 10. Security code review, automata-based programming, securing API (PS, KD)
- 14. 10. Exploits writing (MP)
- 21. 10. Return-oriented Programming (MP)

PS – Petr Švenda, KD – Kamil Dudka, MP – Milan Patnaik

Lectures and content

National holidays, no lecture

- 28. 10. Security primitives: secure channel, secure storage, key management (PS)
- 4. 11. Web programming security, 3rd party libs security, patch management (JM)
- 11. 11. Integrity of modules, parameters, temp files (PR)
- 18. 11. Proper use of (pseudo)-random data (MS)
- 25. 11. Defense in depth (PR)
- 2. 12. Concurrent issues: IPC, race conditions (PR)
- 9. 12. Access control, privilege separation (PR)

PS – Petr Švenda, JM – Jan Masarik, PR – Petr Ročkai, MS – Marek Sýs

Questions