UNIVERSITY OF BRISTOL

Winter Examination Period

FACULTY OF ENGINEERING

2024 Examination for the Degree of
Bachelor and Master of Engineering and Bachelor and Master of Science

COMS10012 and COMSM0085
Software Tools

TIME ALLOWED:
1 Hour

Answers to COMS10012 and COMSM0085: Software Tools

Intended Learning Outcomes:

1. Please make sure you read the instructions on the answer sheet.
2. Each question is worth 1 mark.
3. Only the answer sheet will be marked, the empty pages at the back of the exam are only used for your calculations.
4. When selecting answers, make clear, horizontal marks within the two sets of brackets, making sure that the contained letter is struck through.
5. Avoid marking the answer sheet outside specified areas.
6. Do not crease, dog-ear or otherwise damage the answer sheet.

Q1. Alice is trying to set up key-based login on a service she currently accesses via using `ssh` and entering her password. Here are listings of her `.ssh` directory on her local machine:

```
-rw------- 1 alice alice  389 Jan 19 10:56 authorized_keys
-rw-r--r-- 1 alice alice  395 Feb 21 13:03 id_rsa.pub
-rw------- 1 alice alice 1766 Feb 21 13:03 id_rsa
-rw-r--r-- 1 alice alice  225 Feb 21 13:01 known_hosts
```

And on the server:

```
-rw-r--r-- 1 alice alice 395 Feb 21 13:21 id_rsa.pub
-rw-r--r-- 1 alice alice 225 Jan 19 11:02 known_hosts
```

There's a problem evident with her current setup that is preventing key-based login from working. Identify which file's presence, abscence or visible details indicates the problem.

A. The problem lies with 'authorized_keys' on the server.

B. The problem lies with 'known_hosts' on the local machine.

C. The problem lies with 'id_rsa' on the local machine.

D. The problem lies with 'id_rsa.pub' on the server.

E. I do not want any marks for this question.

Solution: The lack of an 'authorized_keys' file on the server means key-based login won't work. Alice appears to have copied a public key file to the server, but this doesn't achieve anything until the key is added to this file. Key-based login was a focus of the first lab.

Q2. To refresh the local list of available packages in Debian, the best command to use is:

A. apt upgrade

B. apt update

C. vagrant box update

D. apt-cache -gf dump

E. I do not want any marks for this question.

Solution: C and D are commands we have never discussed, neither of which would achieve the expressed aim. The difference between 'apt update' and 'apt upgrade' is explained in the first lab worksheet.

Q3. Jason has a user account `eg1234` on a server accessible via SSH at the domain `jserv.ru`. He wants to copy the file `demo.c` from his current local working directory to the `code` folder in his home directory on that server. Which of these commands should achieve what he wants?

A. `scp ./demo.c eg1234@jserv.ru:/code/`

(cont.)

B. `scp /home/eg1234/demo.c jserv.ru:/home/eg1234/`

C. `scp ~/demo.c eg1234:jserv.ru/home/code/`

D. `scp demo.c eg1234@jserv.ru:~/code/`

E. I do not want any marks for this question.

Solution: A attempts to copy the file to a folder outside of the home directory, B copies the wrong local file and doesn't set the destination as the 'code' folder, and C selects the wrong local file and is completely malformed in addressing the remote destination. We started using scp in the first lab.

Q4. A process has been appending results to a file `output.log`, the full content of which currently looks like this:

```
count: 1
count: 2
count: 2
count: 1
count: 3
count: 2
count: 2
count: 4
count: 1
count: 2
```

You execute the command sequence

```
head -n 6 output.log | uniq | wc -l
```

What would be the output?

A. 4

B. 5

C. 6

D. 8

E. I do not want any marks for this question.

Solution: The first 6 lines contain only one sequential duplicate (the other duplicate '2' doesn't count because the input isn't sorted) so the answer must be 5. The `head`, `uniq` and `wc` utilities were explained in the second lab worksheet.

Q5. Which of the below would redirect both standard output and standard error from the command `ping 1.1.1.1` to `log.txt`?

A. `ping 1.1.1.1 1> log.txt 1> log.txt`

B. `ping 1.1.1.1 2&1> log.txt`

C. `ping 1.1.1.1 2>&1 2> log.txt`

D. `ping 1.1.1.1 > log.txt 2>&1`

E. I do not want any marks for this question.

Solution: A doesn't redirect stderr, C has the right idea but sends stderr to stdout before then redirecting only stderr, B looks sort of plausible but simply isn't valid. A variant of this question was given as an example for exam prep.

Q6. Brian is writing a shellscript, part of which involves printing the contents of the current directory, but while *hiding* file extensions in filenames. Which of the below loops will produce the intended outcome?

A.

```
for file in *;
do
        echo "${file%.*}"
done
```

B.

```
for $file in $(ls);
do
        echo file
done
```

C.

```
for file in $(ls -l);
do
        echo "${file#*.}"
done
```

D.

```
for $file in *;
do
        echo "file%.*"
done
```

E. I do not want any marks for this question.

Solution: B and D are easily identifiable as wrong because they use '$file' to refer to the variable at its definition in the start of the loop – this is not a valid identifier and would not run. In addition, B makes no attempt to remove the file extension, and D doesn't access the variable in the echo command, meaning it will always echo exactly what is shown. C sets the file variable correctly but is iterating through 'ls -l', which contains more information than just the filenames, so would at the least need a lot more processing. The echo line for C is also incorrect, using the code to access just a filename's extension. All the components for this were in the POSIX lecture and shellscripting lab.

Q7. What is the result of the following command?

```
echo "softwaretools" | sed 's/[ft]w[ar]\([^o]*\)o\+/pol\1\1o/'
```

A. sopoletetols

B. sofpolretretols

C. polsoftwaretosoftwaretoo

D. softwaretools

E. I do not want any marks for this question.

Solution: D would only be the answer if there was no match. C mistakes the matching group 1 for the full match (&) and is confused about what that match would be. A means you've misinterpreted the bracket expressions to mean e.g., 'ft' instead of 'either f or t'. All these components were given in the regex lecture and exercises.

Q8. Which of these `grep` commands would print just the lines that contain 'colour' or 'color' (ignoring case) in the file `preferences.conf`?

A. `grep -v 'col[ou]r' preferences.conf`

B. `grep -i 'colo[ou]r' preferences.conf`

C. `grep -i 'colou\?r' preferences.conf`

D. `grep -v 'colo\?u\?r' preferences.conf`

E. I do not want any marks for this question.

Solution: A and D are searching for everything that *doesn't* match the pattern, so can quickly be discarded. The patterns are also wrong. B would match 'colour' but also 'coloor', and doesn't match 'color'.

Q9. Which of these pattern-matching problems could not be solved with a basic regular expression?

A. Andy wants to match an arbitrary number of 'a' characters, then the same number of 'b' characters.

B. Briony wants to match a 'b' character, then exactly six characters from the set 'c,d,e', then an 'f' character.

C. Carl wants to match the word 'cumquat', but only when the first character of the word is incorrect.

D. Denise wants to match either 2 or 3 literal dot characters ('.'), followed by a word of any length, followed by a question mark.

E. I do not want any marks for this question.

Solution: This was a focus of the regular expression lecture – a regular language doesn't have memory, so the first example is impossible. The other options might require thought but are all solveable and can be expressed as a FSM.

Q10. Harvey wants to count how many times the letter 'a' appears in file `wordlist.txt`. Which of the below commands would best achieve that?

A. `grep -c 'a' wordlist.txt`

B. `wc -w wordlist.txt | grep 'a'`

C. `grep -o 'a' wordlist.txt | wc -l`

D. `grep -a wordlist.txt | wc -c`

E. I do not want any marks for this question.

Solution: A is plausible but misses the possibility of there being more than one 'a' on a line in the document – we showed you this issue in the regex worksheet. B is nonsense that misunderstands how wc works, and D is similarly nonfunctional.

Q11. Brian has run the following Git command: `git add README.txt` Which of the following statements is true?

A. Brian wants to edit `README.txt` to *add* extra text.

B. Brian has *commited* `README.txt` to the source history.

C. Brian has *staged* the `README.txt` file.

D. Brian is *pulling* changes to `README.txt` from a remote server.

E. I do not want any marks for this question.

Q12. Which statement best describes what a Git *branch* is?

A. It is a reference to a single commit made in the past.

B. It is a Git repository on a remote server.

C. It is a reference to a series of Git commits that have been in a sequence.

D. It is a single commit independent of other commits.

E. I do not want any marks for this question.

Q13. Who designed Git?

A. Microsoft for their Github tool.

B. Richard Stallman.

C. Joseph Hallett.

D. Linus Torvalds.

E. I do not want any marks for this question.

Q14. A `git pull` is equivalent to which other sequence of Git commands?

A. `git add` then `git commit`

B. `git merge` then `git fetch`

C. `git fetch` then `git push`

D. `git fetch` then `git merge`

E. I do not want any marks for this question.

Q15. When running `git status` you see the following message:

> Your branch and 'origin/main' have diverged and have 7 and 42 commits each respectively.

What does it mean?

A. Since you started work (and made 7 commits) someone else has pushed work containing 42 commits to the origin remote.

B. Your Git repo is corrupt and you need to start again.

C. Since you started work (and made 42 commits) someone else has pushed work containing 7 commits to the origin remote.

D. You have only saved 7 out of the last 42 changes and may have lost work unless you commit soon.

E. I do not want any marks for this question.

Q16. When reading through a source file you find the following text:

```
<<<<<<< HEAD
x += 1;
=======
x++;
>>>>>>> 51224257
```

What is going on?

A. This is SQL: a programming language for interacting with relational databases.

B. There is a merge conflict. There are 51,224,257 lines of additional code that need merging.

C. Your repo is corrupt. Restore from a backup.

D. There is a merge conflict. Commit `51224257` is in conflict with your currently checked out code.

E. I do not want any marks for this question.

Q17. What is `make`?

A. A shellscript to build code.

B. A tool for converting files on the basis of rules.

C. A library management tool for C.

D. An obsolete configuration management tool.

E. I do not want any marks for this question.

Q18. Why might you want to use `maven` instead of `make`?

A. Maven can fetch Java dependencies from remote repos.

B. Make cannot build Java code as the compiler is incompatible.

C. Maven is an open source project from the Apache foundation, whereas Make is closed source.

D. Make is configured using XML which can be hard for a human to read.

E. I do not want any marks for this question.

Q19. What does the following GNU Make patternrule say?

```
%.a: %.b
	foo $< -b $@
```

A. To build a file ending with `.b` (for example `file.b`) from a file ending with `.a` (for example `file.a`) run `foo file.b -b file.a`.

B. To build a file ending with `.a` (for example `file.a`) from a file ending with `.b` (for example `file.b`) run `foo file.a -b file.b`.

C. To build a file ending with `.a` (for example `file.a`) from a file ending with `.b` (for example `file.b`) run `foo file.b -b file.a`.

D. To build a file ending with `.b` (for example `file.b`) from a file ending with `.a` (for example `file.a`) run `foo file.a -b file.b`.

E. I do not want any marks for this question.

Q20. To compile a C source file with debugging symbols available what flag should be used with GCC or Clang?

A. `-g`

B. `--help`

C. `-I`

D. `-O`

E. I do not want any marks for this question.

Q21. Nigel is attempting to write a program, but it is crashing. Read the log from the shell and explain the segmentation fault.

```
$ cat hello.c
#include <stdio.h>

int main(void) {
       FILE *f = fopen("out.txt", "r");
       fprintf(f, "Hello World!\n");
       return 0;
}
$ make hello
cc    hello.c  -o hello
$ ./hello
Segmentation fault (core dumped)
$ strace ./hello
execve("./hello", ["./hello"], 0x7ffeec3cbee0 /* 55 vars */) = 0
brk(NULL)                               = 0x1516000
arch_prctl(0x3001 /* ARCH_??? */, 0x7ffc41be7fb0) = -1 EINVAL (Invalid argument)
access("/etc/ld.so.preload", R_OK) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=125831, ...}) = 0
```

```
mmap(NULL, 125831, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f68e4daf000
close(3)                                = 0
openat(AT_FDCWD, "/lib64/libc.so.6", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\300\250\3\0\0\0\0\0"...,
    832) = 832
fstat(3, {st_mode=S_IFREG|0755, st_size=2164640, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
    0x7f68e4dad000
lseek(3, 808, SEEK_SET)                 = 808
read(3, "\4\0\0\0\20\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0", 32) = 32
mmap(NULL, 4020448, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f68e47c9000
mprotect(0x7f68e4996000, 2093056, PROT_NONE) = 0
mmap(0x7f68e4b95000, 24576, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1cc000) = 0x7f68e4b95000
mmap(0x7f68e4b9b000, 14560, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f68e4b9b000
close(3)                                = 0
arch_prctl(ARCH_SET_FS, 0x7f68e4dae500) = 0
mprotect(0x7f68e4b95000, 16384, PROT_READ) = 0
mprotect(0x600000, 4096, PROT_READ) = 0
mprotect(0x7f68e4dce000, 4096, PROT_READ) = 0
munmap(0x7f68e4daf000, 125831)          = 0
getrandom("\x10\xb5\x2e\xcf\x83\xdc\x98\x2a", 8, GRND_NONBLOCK) = 8
brk(NULL)                               = 0x1516000
brk(0x1537000)                          = 0x1537000
brk(NULL)                               = 0x1537000
openat(AT_FDCWD, "out.txt", O_RDONLY) = -1 ENOENT (No such file or directory)
--- SIGSEGV {si_signo=SIGSEGV, si_code=SEGV_MAPERR, si_addr=NULL} ---
+++ killed by SIGSEGV (core dumped) +++
Segmentation fault (core dumped)
```

A. Nigel is attempting to write to a file, but only opened it with read permissions.

B. Nigel compiled the program with `make` which used `cc` to compile it but the C compiler is `clang`.

C. Nigel cannot open `out.txt` because it doesn't exist.

D. The call to `fopen` returned a `NULL` pointer which was dereferenced by `fprintf`.

E. I do not want any marks for this question.

Q22. What is `gdb`?

A. A typo. You probably meant GCC the C compiler.

B. The GNU Debugger: a program for figuring out what happens when programs run.

C. A commandline interface to the Godbolt compiler explorer.

D. The GNU Database: a modern relational database for running SQL commands.

E. I do not want any marks for this question.

Q23. When is a spreadsheet an appropriate tool to use to store important data?

A. When you need to store large quantities of data.

B. When you are doing double entry bookkeeping.

C. When you are following a rigorous software engineering process.

D. When you need to store nationally important data (such as for a national contact tracing system).

E. I do not want any marks for this question.

Q24. What is a *composite key*?

A. A number added to a database table to uniquely identify rows.

B. A key for a database table consisting of multiple attributes.

C. A key for a database table consisting of multiple attributes of different types.

D. The primary key for a database table.

E. I do not want any marks for this question.

Q25. How many attributes will a database table in 6NF have?

A. 6NF places no restrictions on the number of attributes.

B. 0

C. 1

D. <2

E. I do not want any marks for this question.

Q26. What is an `INNER JOIN`?

A. A join where if a row can't be joined to another row `NULL`s will be inserted.

B. A join where the data will be glued together only on the inside (leaving a smooth exterior).

C. A join where neither of the joining columns can be `NULL`.

D. A join where the join condition must be a numeric comparison.

E. I do not want any marks for this question.

Q27. What does the following SQL query do:

```
SELECT Movie.title
FROM Movie
WHERE Movie.lead = 'Keanu %'
;
```

A. It finds all of the films *Keanu Reeves* starred in.

B. It searches for movies where the lead actor is *Keanu %*.

C. It finds all of the films where the lead actor isn't called *Keanu*.

D. It searches for movies where the lead actor's first name is *Keanu*.

E. I do not want any marks for this question.

Q28. What does the following SQL query do:

```
SELECT Movie.title, Movie.revenue
FROM Movie
WHERE Movie.lead IS 'Keanu Reeves'
ORDER BY Movie.revenue DESC
LIMIT 3
;
```

A. It finds Keanu Reeves' top 3 films by revenue.

B. It finds Keanu Reeves' bottom 3 films by revenue.

C. It finds all of Keanus Reeves' films and sorts in terms of revenue.

D. It finds 3 films staring Keanu Reeves (though which 3 is undetermined).

E. I do not want any marks for this question.

Q29. What is an SQL *transaction*?

A. A series of queries that must be run in sequence and if any query fails then appropriate action taken.

B. An SQL query made via a API for a different programming language.

C. A single SQL query.

D. Any operation which alters the state of the database.

E. I do not want any marks for this question.

Q30. Why might you not want to use a relational database and SQL?

A. Your application is programmed in a different language.

B. You are building a Track and Trace system.

C. The data you want to store and queries you want to make are recursive in nature.

D. The data you want to store needs to reside on a separate server.

E. I do not want any marks for this question.

Q31. Consider the following Datalog program:

```
sibling(A,B) :- parent(A, C), parent(B, C).
parent(jo, john).
parent(john, jean).
parent(james, jo).
parent(lou, john).
parent(oliver, jo).
parent(simon, jean).
parent(flipsy, james).
```

Who is Jo's sibling?

A. Lou

B. Flipsy

C. Simon

D. James

E. I do not want any marks for this question.

Q32. What is the command to read your system's documentation?

A. `help`

B. `apropos`

C. `man`

D. `firefox https://openai.com/chatgpt/`

E. I do not want any marks for this question.

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