1 Übung IBN

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Aufgabe 1

- The focused thinking mode takes your thoughts along familiar paths. It helps solve problems with the help of approaches that are already known.
  The diffused thinking mode is a more relaxed and free approach. It might be harder to stick to a certain idea, but that is the whole reason why it might be effective. Its useful for coming up with new concepts and gives the freedom a creative solution requires.

  a) **Focused Thinking** - Learning Vocabulary is a repetitive task, that every person may develop a different technique for, but the pattern is always the same.

  b) **Diffuse Thinking** - This is where the freedom of thought comes in handy.

  c) **Focused Thinking** - To learn a new method for calculation, the diffused thinking mode might be beneficial. But if training is what is needed, repeating the same method for different problems over and over again, seems like the best approach

  d) **Both Modes** - This is where both modes come together. To really understand everything that is taught in the lecture, one needs to switch between modes whenever its necessary, because the lecture (for most people anyway) teaches both new concepts, and requires to practice programming.

- Salvador Dali and Thomas Edison are supposed to have used the same technique to enter these Modes. It is said, that they would try to fall asleep with something in their hand, so that once they barely got to enter their dreams, they would drop the object, and immediately wake up again. They would then use the newly found ideas they got in this diffused mode and would sit down at their desk and start focussing on the new thought patterns. That way, they supposedly could quickly come up with new ideas, and start manifesting them by giving them a framework.

- John Cleese describes the two modes as ”open” and ”closed”. They’re the equivalent of ”diffuse” and ”focused” respectively. The open mode allows for creativity, and seeing clues in problems that are not yet understood, while it is bad for decisiveness. Only in the focused mode one can really implement the ideas and go through with them undistracted.

- An example for a great discovery made in the open mode is the discovery of Penicillin. It was likely only discovered because Fleming looked at a dish that hadn’t grown a culture, and instead of disposing of it, because of assuming that there was something wrong with it, he saw a clue, during that time he was in the open mode. In the

closed mode, one tends to follow things they know, unaccepting of deviations from their expectations.

- Alfred Hitchcock was of the opinion, that working under pressure does not lead to good results, so that whenever their team was arguing about something he would rapidly change the topic, so that moods would calm down, and become more relaxed, allowing for that open/diffused thinking.

Aufgabe 2

Abstraction describes the process of hiding the underlying complexity of a problem for the purpose of simplifying it and is used in programming to help visualise routines or algorithms. Lower levels of abstractions are generally find the closer one gets to hardware, while higher levels of abstraction are concerned with the general logic of the software.
An advantage of abstraction is to avoid duplicates in code for software development. By writing subroutines or concepts, working towards a solution for a given problem becomes easier, since less time will be spent writing the same code over and over again while losing control of the big picture.
A clear disadvantage is the loss of detail, which can lead to inefficiencies in software.

Aufgabe 3

There are two possibilities:

- cache hit with t_c
- cache miss with $t_c + t_r$

$$\begin{aligned} & t_{\text{ave}} = (p_+ \cdot t_c) + ((1 - p_+) \cdot (t_c + t_r)) \\ \Rightarrow\ & t_{\text{ave}} = (p_+ \cdot t_c) + (t_c + t_r - p_+ \cdot t_c - p_+ \cdot t_r) \\ \Rightarrow\ & t_{\text{ave}} = t_c + t_r - p_+ \cdot t_r \end{aligned}$$

Aufgabe 4

Let $t_{\text{ave}} \leq 5t_c, \quad t_r = 100t_c$:

$$\begin{aligned} & t_c + t_r - p_+ * t_r = t_{\text{ave}} \\ \Rightarrow\ & t_c + 100t_c - p_+ \cdot t_r \leq 5t_c \\ \Rightarrow\ & 101t_c - p_+ \cdot t_r \leq 5t_c \\ \Rightarrow\ & p_+ \cdot t_r \geq 101t_c - 5t_c \\ \Rightarrow\ & p_+ \cdot t_r \geq 96t_c \\ \Rightarrow\ & p_+ \geq 96\frac{t_c}{t_r} \\ \Rightarrow\ & p_+ \geq \frac{96t_c}{100t_c} \\ \Rightarrow\ & p_+ \geq 0.96 \end{aligned}$$

The probability p_+ has to be larger than 96%

Aufgabe 5

Name	GPR	MMX	XMM
Purpose	General	Int/Word operations	Fl.-Point Operations
Size	64 Bits	64 Bits	128 Bits
# of Registers on the CPU	16	8	16
Total capacity in Bits	1024	512	2048
Total capacity in bytes	128	64	256

That makes a total of $128 + 64 + 256 = 448$ bytes, which is small compared to the 1 GiB RAM (0.0000417 %).

Aufgabe 6

The POSIX API uses abstractions to "hide" the internal funcionality from the programmer. This is mainly for the purpose of simplification, and can lead to the program to do a system call unknowingly. Since system calls take time, this can lead to the program slowing down. However, most times these system calls have to be performed in order to do the necessary calculations. So it might be a good idea to keep them to a minimum, but this is usually handled by the libraries themselves, and a programmer doesn't need to spend too much time optimising. Coding efficiently however stays beneficial, especially when it comes to the design of complex programs that need to be run many times over.

Aufgabe 7

All exec() functions replace the current process image with a new one. The following functions are layered on top of execve. They can be grouped the following:

Functions with the "-l" suffix: `execl(), execlp(), execle()`
The list of arguments available to the executed program must be terminated by a NULL pointer. By contrast to the 'l' functions, the 'v' functions specify the command-line arguments of the executed program as a vector.
Functions with the "-v" suffix: `execv(), execvp(), execvpe()`
The argument list is represented by an array of pointers. The array of pointers must be terminated by a NULL pointer.
Functions with the "-e" suffix: `execle(), execvpe()`
The environment of the caller is specified via the argument `envp`. All other `exec()` functions (without the -e suffix) take the environment for the new process image from the external variable `environ` in the calling process.
Functions with the "-p" suffix: `execlp(), execvp(), execvpe()`
These functions duplicate the actions of the shell in searching for an executable file if the specified filename does not contain a "/" character. If it does contain a "/" character, then

PATH is ignored, and the file a the specified pathname is executed.
In addition, certain errors are treted specially, for example if permission is denied for a file (EACCES, will continue searching PATH) or the header of a file isn't recognized (ENOEXEC, will execute shell with /bin/sh). All other functions (without the -p suffix) take a pathname that identifies the program to be executed
All listed functions and their signature can be found in the following:

```
int execl(const char *pathname, const char *arg, ... ,(char*) NULL):
```

```
int execlp(const char *file, const char *arg, ... , (char*) NULL;
```

```
int execle(const char *pathname, const char *arg, ... , (char*) NULL, char *const
    envp[]);
```

```
int execv(const char *pathname, char *const argv[]);
```

```
int execvp(const char *file, char *const argv[]);
```

```
int execve(const char *pathname, char *const argv[], char *const envp[]);
```

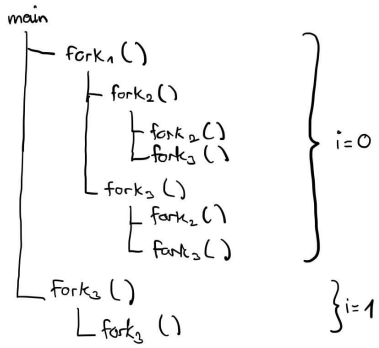
```
int execvpe(const char *file, char *const argv[], char *const envp[]);
```

In the first order, the functions execv() and execl() only differ in the format of the arguments. They both end up calling the same underlying system call execve(). In this case, execv() is solely for convenience: If the number of arguments is fixed, it allows to avoid creating an array.

Aufgabe 8

The function fork() returns the process ID of the child process in case the fork has worked. If it failed, fork() returns a "-1".

a. The program creates 9 processes in total. Assuming the first fork() call is called $\text{fork}_1()$ etc., the process tree would look like this:



b. The maximum processes to be started with this program is 11, if one assumes the pid of the first fork to be ending on a 1. That means exactly 10 forks take place, including the parent process, that makes 11.
If other processes are started during this process, they might take up a process id in between, which can increase or reduce the number of forks.

Aufgabe 9

a) `vim`: Software to view and edit text. Everything is controlled with the keyboard and can run in a single shell.
`cat`: Prints a file on the standard output (the shell), can be navigated with the scroll wheel.

b) Assuming we use vim. With `Ctrl-Z` the current job can be stopped. Then the shell can be used for reading emails (the hardcore vim user might install the ruby-mail plugin to do this directly in vim aswell). After reading the mail, with `jobs`, the job id from the previously stopped job can be seen, and reopened using `fg %[jobid]`. This will get back to where one has left off.

c) With `cp [file] [destination] &` copying can be done in the background. Then one can get back to reading. In Theory, only 2 processes are needed for this.One that handles the copying, and one is the program used to read.

Aufgabe 10

During the era of punch cards, writing and compiling code was very slow. Programmers had to really make sure their program works before testing, as the testing procedure would cost them lots of time. It was usually faster to debug the code by hand, instead of compiling it over and over again.
Today we use sophisticated error messages and compile programs in the matter of seconds. We can test subroutines seperately, and use editors, that will precompile code as we write, showing us where typos might've creeped in, or declarations might've been forgotten.