Computer Architecture and Programming Languages
Jacobs University Bremen
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Course: CO20-320241
November 25th, 2019

Homework 11 - Pipelining and Regular Expressions

- Template file for submitting the solutions:
  https://grader.eecs.jacobs-university.de/courses/320241/2019_2/lectures/template_hw.tex
- The TAs are grading solutions to the problems according to the following criteria:
  https://grader.eecs.jacobs-university.de/courses/320241/2019_2/Grading_Criteria_CAPL.pdf

Problem 11.1 *Speedup computations* (3 points)

Use the data from the example given on slide 29 (Lecture 20 & 21) and assume that you have to execute a program containing 2 load instructions, 1 store instruction, 3 R-format instructions and 1 branching instruction for computing the speedup related to the execution time in the following scenarios:

(a) multi-cycle approach compared to single cycle approach,

(b) pipelined approach compared to single cycle approach,

(c) pipelined approach compared to multi-cycle approach.

Problem 11.2 *Regular expressions I* (4 points)

Use the following table:

EXPRESSION	MATCHES	EXAMPLE
c	the one non-operator character c	`a`
$\backslash c$	character c literally	`\*`
`"`s`"`	string s literally	`"**"`
`.`	any character but newline	`a.*b`
`^`	beginning of a line	`^abc`
`$`	end of a line	`abc$`
$[s]$	any one of the characters in string s	`[abc]`
$[\hat{}s]$	any one character not in string s	`[^abc]`
$r*$	zero or more strings matching r	`a*`
$r+$	one or more strings matching r	`a+`
$r?$	zero or one r	`a?`
$r\{m,n\}$	between m and n occurrences of r	`a{1,5}`
$r_1 r_2$	an r_1 followed by an r_2	`ab`
$r_1 \mid r_2$	an r_1 or an r_2	`a|b`
(r)	same as r	`(a|b)`
r_1/r_2	r_1 when followed by r_2	`abc/123`

Write regular expressions for recognizing the following:

(a) the string `$zero`,

(b) all strings which start with `a` and end with `b` and may contain any other letters or digits,

(c) all strings which start and end with a digit and may contain letters, digits, and underscores,

(d) all strings which contain only the characters `a` and `b`, start with `abb` following by at least `4` `a`, the total length of the string should not be longer than `10` characters,

(e) all positive integer numbers,

(f) all integer numbers,

(g) all positive floating point numbers,

(h) the strings `pit`, `spot`, `spate`, `slap two`, `respite` but it should not recognize the strings `pt`, `Pot`, `peat`, `part`.

Problem 11.3 *Regular expressions II* (4 points)

Which of the following matches the regular expressions:

(a) `ab+c?` (including `?`)

(1) `abc`
(2) `ac`
(3) `abbb`
(4) `bbc`

(b) `a.[bc]+`

(1) `abc`
(2) `abbbbbbbb`
(3) `azc`
(4) `abcbcbcbc`
(5) `ac`
(6) `asccbbbbcbcccc`

(c) `(very )+(happy )?((CS)|(IMS)|(ECE)) student`

(1) `very happy student`
(2) `happy CS student`
(3) `very very happy ECE student`
(4) `very very very happy IMS student`
(5) `very very very very IMS student`

(d) `<[^>]+>`

(1) `<an xml tag>`
(2) `<opentag> <closetag>`
(3) `</closetag>`
(4) `<>`
(5) `<with attribute="77">`

How to submit your solutions

You can submit your solutions via *Grader* at **`https://grader.eecs.jacobs-university.de`** as a generated PDF file from the given template TEX file.
If there are problems with *Grader* (but only then), you can submit the file by sending mail to `k.lipskoch@jacobs-university.de` **with a subject line that starts with CO20-320241**.

Please note, that after the deadline it will not be possible to submit solutions. It is useless to send solutions by mail, because they will not be graded.

This homework is due by Monday, December 2nd, 23:00.