

Exam in course

TDDA 37, TDDDB 44 Compiler construction 2000-12-20, 08.00 - 12.00

Aids: None.

Max = 32 points, 16 points to pass.

Jourhavande lärare: Jonas Wallgren (only by phone)

### Problem 1 (2p) Phases and passes

What is a phase and what is a pass? What phases does a compiler normally consist of?

### Problem 2 (2p) Symbol table

Describe how a symbol table in principle, independent of how it is represented, handles

- a) Variable declaration,
- b) Variable use,
- c) Entrance into a block,
- d) Exit from a block.

### Problem 3 (4p) Top-down parsing

Explain and remedy the problems in the grammar

$$\begin{aligned} X &::= aX \mid Xb \mid aYb \mid p \\ Y &::= bY \mid Ya \mid bXa \mid q \end{aligned}$$

which should be used for recursive descent parsing.

### Problem 4 (4p) LR parsing

If the grammar

$$\begin{aligned} X &::= aX \mid Xb \mid aYb \mid p \\ Y &::= bY \mid Ya \mid bXa \mid q \end{aligned} \quad ,$$

where  $X$  is the start symbol, is SLR(1) or even LR(0) then show, using tables and stack, how the string  $abpab$  is parsed. If the grammar is not then show how it could be rewritten to (at least) SLR(1) (and still describe the same language).

### Problem 5 (5p): Intermediate code generation

Translate the following code segment to quadruples, postfix code, and abstract syntax tree:

```
while y>37 do
  if i>15
    then x:=x+1
    else y:=y-1;
```

### Problem 6 (3p) Code optimization

What is a loop?

Explain, using clear examples, the loop optimization methods presented in the course.

## Problem 7 (6p) Syntax directed translation

The following grammar rule describes a for loop:

`<loop> ::= for <var> in <expr>..<expr> loop <stmt_list> end loop`

`<var>` takes the values between the two expressions (the endpoints included) one by one, and for each value `<stmt_list>` is executed. Eg:

```
for x in 1..5 loop
  print(x);
end loop;
```

prints the numbers 1 to 5.

a) Write a syntax directed translation scheme, using attributes and semantic rules, for the grammar rule above. The values of the both `<expr>`s are computed in the beginning and cannot be changed during the execution of the loop. Neither can `<var>` be changed inside the loop.

b) What changes must be done to the solution to a) if `<stmt_list>` is allowed to change the loop variable and the endpoints? You don't need to give a complete, detailed solution, just to state which parts and how, in principle.

Eg (b):

```
for x in a..b loop
  b:=b-1; --changes upper endpoint
  x:=x+1; --changes x (not the loop mechanism)
end loop;
```

## Problem 8 (2p) Boot strapping

On the M machine there is a compiler for the high level language S. There is an executable version and a source code version - it's written in S itself.

What is the most simple procedure to implement S on N, a machine where there is no S compiler?

## Problem 9 (4p) Code generation for RISC

a) What is branch prediction and when is it used? Give an example! Why is it important for pipelined processors?

b) Shortly explain software pipelining. Give a simple example.