

## CS 405/505 EXAM #1 SAMPLE QUESTIONS (SOLUTION)

1. The string representation of a token is called a(n) lexeme.
2. True or False. Context-sensitive syntax refers to that part of a context-free grammar that requires nondeterminism to be parsed.

False. Context-sensitive syntax is the same as static semantics, which means the correctness of the syntax with respect to context, such as the symbol table, e.g. type compatibility of left and right sides of an assignment statement.

3. List the phases of a *compiler*. Discuss in detail what each phase does and how the phases interact with each other. (You may draw a diagram to assist in this discussion if you wish.) Explain how an *interpreter* is different from a compiler.

**Described in section 1.71-1.7.3 of the textbook.**

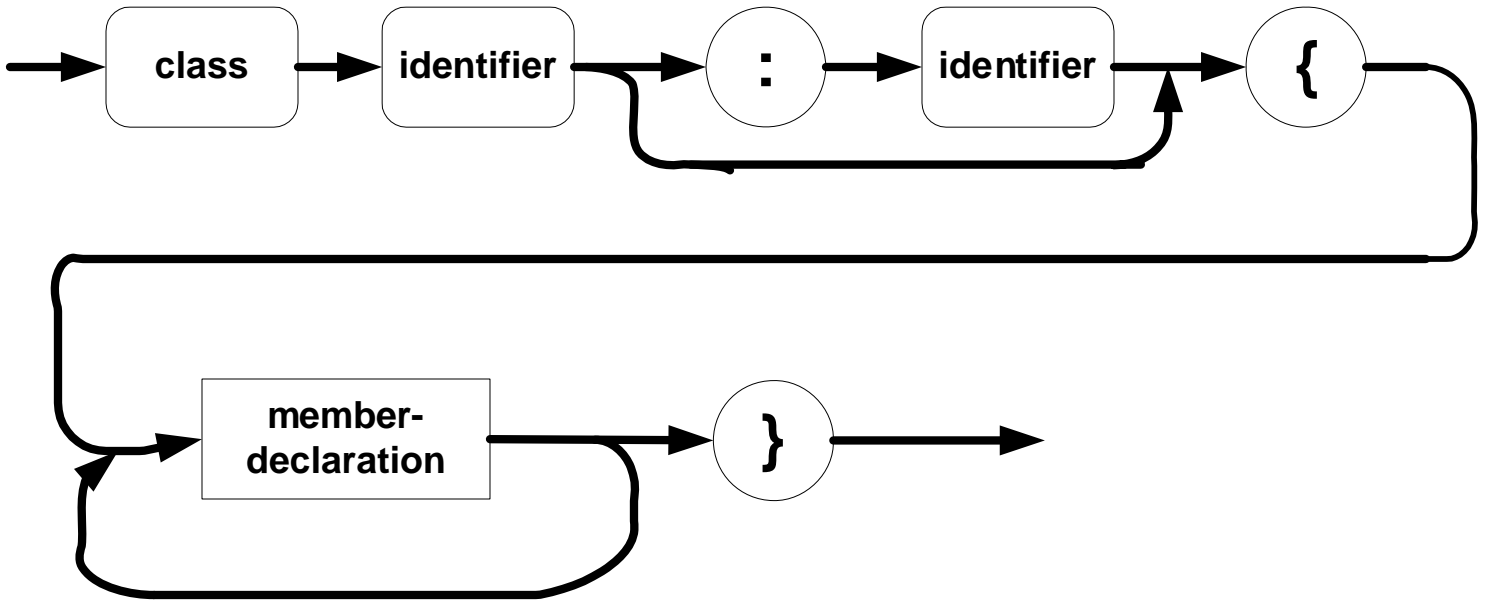
4. A C++ class declaration is described in Extended Backus-Naur form as:

```
class-specifier ::=
    class identifier [ : identifier ] { member-declaration {member-declaration} } }
member-declaration ::= identifier identifier function-definition
    | int identifier function-definition
```

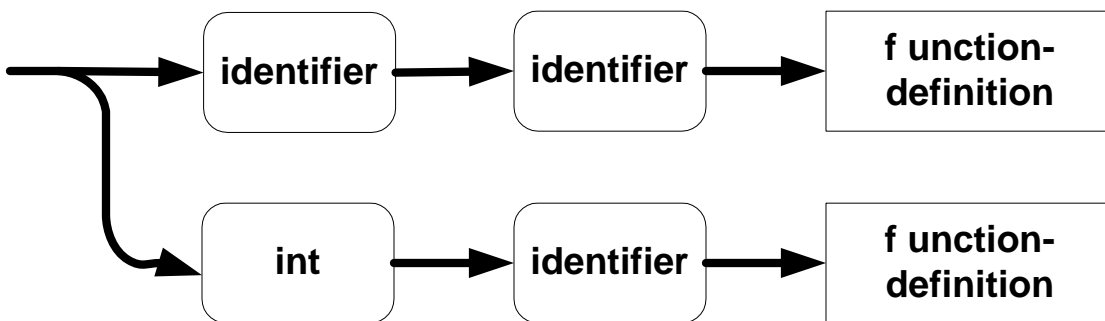
Note that this syntax contains terminal symbols { and } which are different from the extended BNF meta-symbols { and }, and distinguished by underlining. Write an equivalent syntax graph and a recursive descent parser for this construction. Assume the existence of production rules for function-definition and corresponding parsing procedure FUNCTION\_DEFINITION, and a scanning procedure GET\_TOKEN to set a global string variable TOKEN to the token type of the next token. Furthermore, assume that TOKEN is already set to the first token when parsing begins.

The syntax graph is:

## class-specifier



## member-declaration



The recursive descent parser is:

```
procedure CLASS_SPECIFIER;
begin
  if TOKEN != CLASS then ERROR;
  GET_TOKEN;
  if TOKEN != IDENTIFIER then ERROR;
  GET_TOKEN;
  if TOKEN = COLON then begin
    GET_TOKEN;
    if TOKEN != IDENTIFIER then ERROR;
    GET_TOKEN;
  end;
  if TOKEN != LEFT_BRACE then ERROR;
  GET_TOKEN;
  repeat
    MEMBER_DECLARATION;
  until TOKEN = RIGHT_BRACE;
  GET_TOKEN;
end;

procedure MEMBER_DECLARATION;
begin
  if TOKEN = IDENTIFIER then
    GET_TOKEN;
  else if TOKEN = INT then
    GET_TOKEN;
  else
    ERROR;
  if TOKEN != IDENTIFIER then ERROR;
  GET_TOKEN;
  FUNCTION_DEFINITION;
end;
```

5. Consider the attribute grammar below:

```
<string> ::= <a-n> <b-n> <c-n>
    <b-n> . count ← <a-n> . count
    <c-n> . count ← <a-n> . count
<a-n> ::= a
    <a-n> . count ← 1
    | <a-n>1 a
    <a-n> . count ← <a-n>1 . count + 1
<b-n> ::= b
    Condition: <b-n> . count = 1
    | <b-n>1 b
    <b-n>1 . count ← <b-n> . count - 1
<c-n> ::= c
    Condition: <c-n> . count = 1
    | <c-n>1 c
    <c-n>1 . count ← <c-n> . count - 1
```

(a) Indicate which attributes are inherited, which are synthesized, and which are intrinsic.

```
inherited - count of <b-n> and <c-n>
synthesized - count of <a-n>
intrinsic - none
```

(b) Draw the attributed parse tree for the string “aaabbbccc”, showing clearly the order of evaluation of all attributes.

