

**Stanford University
Computer Science Department**

Fall 2002 Comprehensive Exam in Compilers

1. **Closed Book:** no notes, textbooks, laptops, Internet access, etc.
 2. **Write only in the Blue Books:** No credit for answers written on these exam pages.
 3. **Write Magic number** on the cover of **EACH blue book**.
 4. **The exam is timed for 30 minutes.**
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The following is a statement of the Stanford University Honor Code:

- A. *The Honor Code is an undertaking of the students, individually and collectively:*
 1. *that they will not give or receive aid in examinations; that they will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading;*
 2. *that they will do their share and take an active part in seeing to it that others as well as themselves uphold the spirit and letter of the Honor Code.*

- B. *The faculty on its part manifests its confidence in the honor of its students by refraining from proctoring examinations and from taking unusual and unreasonable precautions to prevent the forms of dishonesty mentioned above. The faculty will also avoid, as far as practicable, academic procedures that create temptations to violate the Honor Code.*

- C. *While the faculty alone has the right and obligation to set academic requirements, the students and faculty will work together to establish optimal conditions for honorable academic work.*

COMPILERS COMPREHENSIVE EXAM

Autumn 2002

This is a 30 minute, closed book exam. Please mark your answers in the blue book.

1) Give a context free grammar that will describe the set of strings that are palindromes over the alphabet $\{0, 1, \dots, 9\}$ (2 pts)

2) Given the following code:

```
1: #include <stdio.h>
2:
3: int main () {
4:   int foo [10];
5:   foo++;
6:   printf ("Hello world!");
7:   return 7
8: }
```

Clearly this code has some errors in it. Assuming each error in the code would be reported by the compiler (and that one error would not affect the next), what lines would cause the compiler to error and which stage of compilation would detect the error (lexing, syntax or semantic analysis)? Justify your responses. (4 pts)

3) Is the following grammar LL(1)? If not, can the language that it describes be expressed with an LL(1) grammar? Justify your response. (7 pts)

```
S --> Tu | wx
T --> Sq | vvS
```

4) In one or two sentences only, briefly describe why the class of LR(1) grammars can describe more languages than the class of LL(1) grammars. (8 pts)

5) Sometimes the basic compiler optimizations can actually slow down the code being compiled. Write a snippet of code that demonstrates how the application of simple compiler optimizations may cause the generated code to be slower than the "unoptimized" version. Justify your response. (9 pts)