Math/CSE 1560 Midterm test (version B) - solutions
Winter 2011
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1. (20 points) Write 1-2 line answers for each of the following parts.

   (a) (4 points) What is the response you expect to the following lines of code?

   ```
   nops({seq(-i^2,i=1..4)});
   ```

   Solution: nops() counts the number of items in a list or set and in this case the seq command produces a set of 4 distinct items. So the answer is 4.

   (b) (4 points) What is the response you expect to the following lines of code (you can paraphrase the response from Maple)? Why?

   ```
   a:= proc(n::integer)
   print(n);
   end proc;

   a(3.1);
   ```

   Solution: The precise error message output by Maple is *Error, invalid input: a expects its 1st argument, n, to be of type integer, but received 3.1.* If you paraphrase this you would get credit.

   (c) (4 points) What is the response you expect to the following lines of code? Why?

   ```
   a:= proc(n::integer)
   local b;
   b:=n+n;
   end proc;

   a(3);
   b;
   ```

   Solution: The procedure call $a(3)$ returns 6 but b is not defined (there is no error though) since the assignment of 6 to b was within a procedure, where b was a local variable.

   (d) (4 points) Add a comment of the form "This procedure....." to the following procedure to make it very easy for a Maple programmer to understand.

   ```
   unknown := proc (n::integer)
   local f;
   f :=( n, i)  -> piecewise( frac (n / i) = 0, i, frac (n / i) <>0, -100) ;
   return  {seq (f( n, i) , i = 1..n)}  minus  {-100};
   end proc;
   ```

   This procedure returns a set containing all the divisors of the input integer n (including 1 and n).

   (e) (4 points) What is the value of d in the following lines of code? Why?

   ```
   a := proc (n::integer)
    local b;
    b := 2*n;
    print(b);
   end proc;

   bb := proc ()
    local c;
   ```

```
 c := a(4);
 return c
end proc;

d := bb();
```

Solution: The correct answer is that d is NULL but "d is undefined" would get you full credit. The reason that d is not 8 is because the procedure a prints but does not return 8. Therefore c is not set in procedure bb and it follows that d is not set to 8.

Note: Some students have claimed d is 8 on their versions of Maple. I have not seen the claim being substantiated. My answer is based. on Maple 12.

2. (10 points) Write a procedure that contains two local functions. The procedure should take as input an integer n. The first function should compute the number of digits of n. The second function should compute the i^{th} digit of n. The procedure must use these functions to return the largest digit used in the decimal representation of n. For example, if $n = 1238$, the procedure should return 8.

   Solution:

```
p2 := proc (n::integer)
local x, i,numdig,ithdig;

numdig := n -> 1+trunc(evalf(log10(n)));
 ithdig := (n, k) -> iquo(irem(n, 10^k), 10^(k-1)) ;

x := {seq(ithdig(n, i), i = 1 .. numdig(n))};
return max(x)
end proc;
```

   Note: A very minor twist on a solved practice problem for the midterm.

3. (a) (8 points) Write down a Maple command to plot the line $x + y = 2$ in the first quadrant only (i.e. both x and y are non-negative). You must use the parametric form of the given line to do this.

   Solution:

```
plot([t,2-t,t=0..2]);
```

   (b) (4 points) What is the output of the command `seq(i,i=3..1);`.

   Solution: The command returns NULL but "does not output anything" would get you full credit. This is because sequence generates numbers that are greater than or equal to the first (left) limit **and** less than or equal to the second (right) limit.

   (c) (8 points) Use the map() command to compute the set $\{1, 4, 9, 16, 25\}$ (note that these are the squares of the first 5 positive integers).

   Solution:

```
map(i->i^2,{1,2,3,4,5});
```

4. (10 points) Write a procedure that takes as input an integer n and returns a set defined by $\{i^3 : i \text{ is a factor of } n\}$.

   Solution:

```
quadfactorlist := proc (n::integer)
local divisor,rset;
divisor :=  (n, i) -> piecewise(frac(n/i) = 0, i, frac(n/i) <> 0, -100);
rset:={seq(divisor(n, i), i = 1 .. n)} minus {-100} ;
return map(i->i^2,rset);
end proc;
```