Access Control and Privacy Policies (11)

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Slides: KEATS (also homework is there)

- Imagine you have an completely innocent email message, like birthday wishes to your grandmother? Why should you still encrypt this message and your grandmother take the effort to decrypt it?

  (Hint: The answer has nothing to do with preserving the privacy of your grandmother and nothing to do with keeping her birthday wishes super-secret. Also nothing to do with you and grandmother testing the latest encryption technology, nor just for the sake of it.)

Interlock Protocol

Protocol between a car C and a key transponder T:

1. C generates a random number N
2. C calculates $(F, G) = \{N\}_K$
3. $C \to T$: N, F

4. T calculates $(F', G') = \{N\}_K$
5. T checks that $F = F'$
6. $T \to C$: N, G'
7. C checks that $G = G'$

Zero-Knowledge Proofs

Essentially every NP-problem can be used for ZKPs

- modular logarithms: Alice chooses public A, B, p; and private x

$$A^x \equiv B \; mod \; p$$

Modular Arithmetic

It is easy to calculate

$$? \equiv 46 \; mod \; 12$$

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$$10 \equiv 46 \; mod \; 12$$

A: 10

Modular Logarithm

Ordinary, non-modular logarithms:

$$10^{?} = 17$$

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$$\begin{aligned} \Rightarrow \quad & log_{10} 17 = 1.2304489\ldots \\ \Rightarrow \quad & 10^{1.2304489} = 16.999999 \end{aligned}$$

Conclusion: 1.2304489 is very close to the *true* solution

Modular Logarithm

In contrast, modular logarithms behave much differently:

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I could be tempted to try 28305820...but the real answer is 12314.

Commitment Stage

1. Alice generates z random numbers $r_1, ..., r_z$, all less than $p - 1$.
2. Alice sends Bob for all $1..z$

$$h_i = A^{r_i}\ mod\ p$$

3. Bob generates random bits $b_1, ..., b_z$ by flipping a coin
4. For each bit b_i, Alice sends Bob an s_i where

$$\begin{array}{ll} b_i = 0: & s_i = r_i \\ b_i = 1: & s_i = (r_i - r_j)\ mod\ (p-1) \end{array}$$

where r_j is the lowest j with $b_j = 1$

Commitment Stage

1. Alice generates z random numbers $r_1, \ldots, r_z$, all less than $p - 1$.
2. Alice sends Bob for all 1

$$b_i = A$$

Alice r_i:	4	9	1	3
Bob b_i:	0	1	0	1
		$\uparrow$		
		j		

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Confirmation Stage

1. For each b_i Bob checks whether s_i conforms to the protocol

$$\begin{array}{ll} b_i = 0: & A^{s_i} \equiv h_i \; mod \; p \\ b_i = 1: & A^{s_i} \equiv h_i * h_j^{-1} \; mod \; p \end{array}$$

Bob was sent

$$h_1, \ldots, h_z,$$
$$r_1 - r_j, r_2 - r_j, \ldots, r_z - r_j \;\; mod \; p - 1$$

where the corresponding bits were 1; Bob does not know r_j, he does not know any r_i where the bit was 1

Confirmation Steps

$$\begin{aligned} A^{s_i} &= A^{r_i - r_j} \\ &= A^{r_i} * A^{-r_j} \\ &= h_{r_i} * h_{r_j}^{-1} \; mod\; p \end{aligned}$$

- For each b_i Bob checks v
  the protocol

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Proving Stage

1. Alice proves she knows x, the discrete log of B she sends

$$s_{z+1} = (x - r_j)$$

2. Bob confirms

$$A^{s_{z+1}} \equiv B * h_j^{-1} \; mod \; p$$

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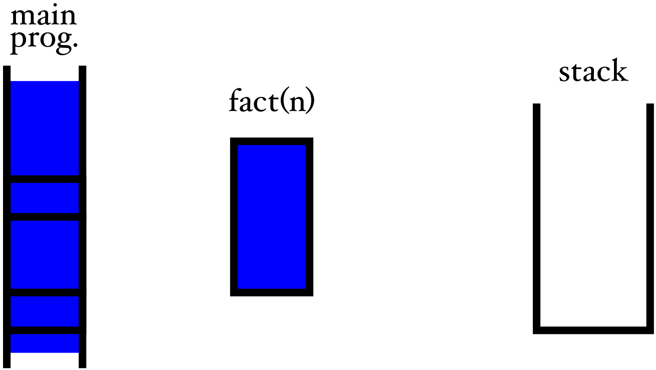
In order to cheat, Alice has to guess all bits in advance. She has only $\frac{1}{2}^z$ chance of doing so.

Buffer Overflow Attacks

- the problem arises from the way C/C++ organises its function calls



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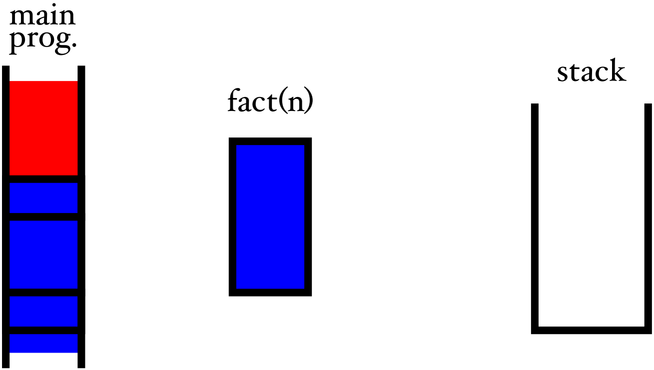

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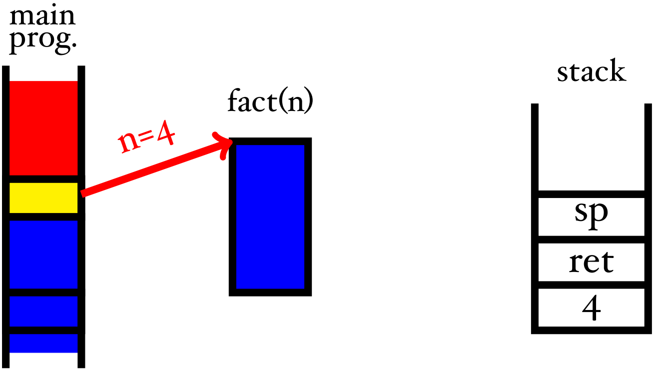

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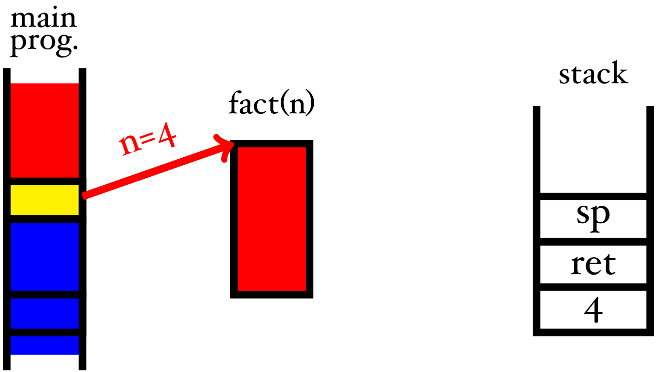

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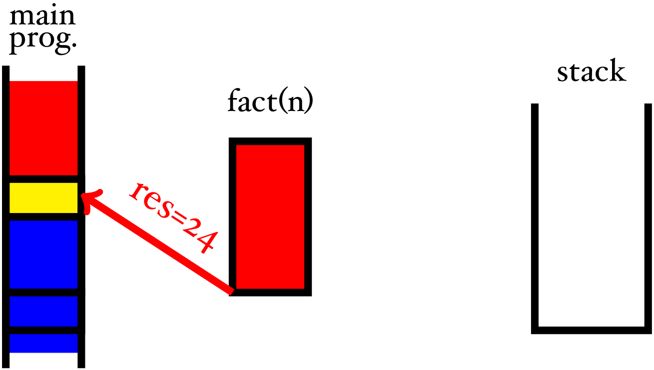

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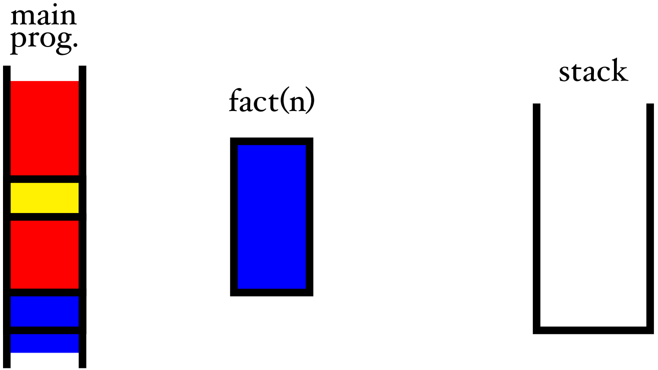

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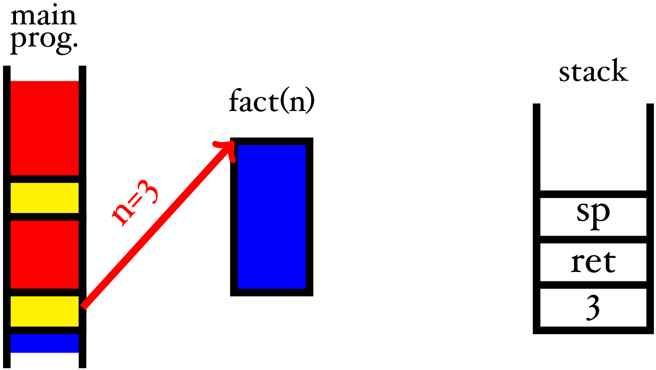

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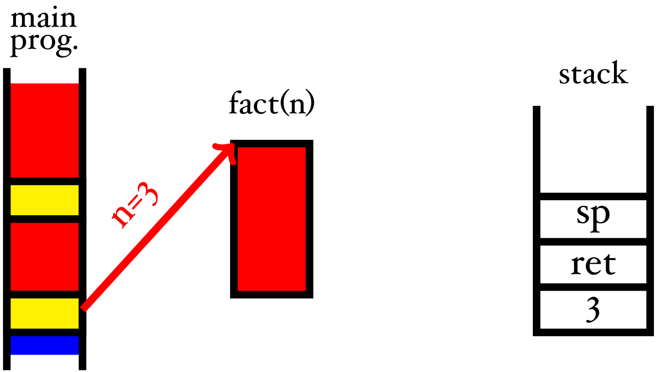

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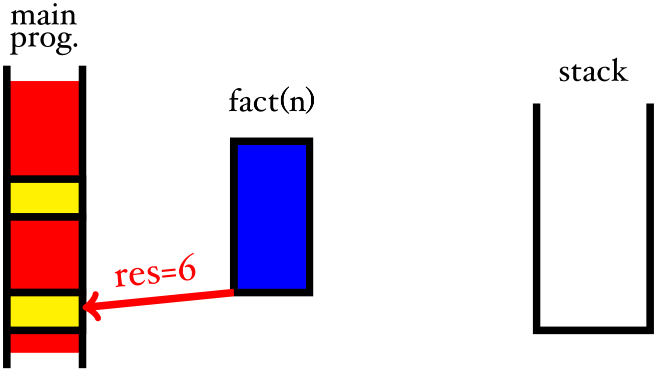
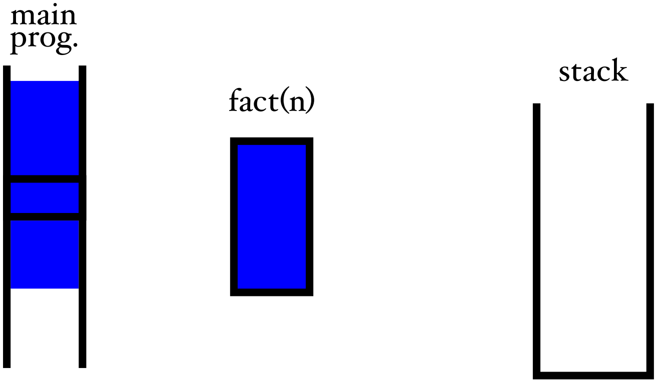
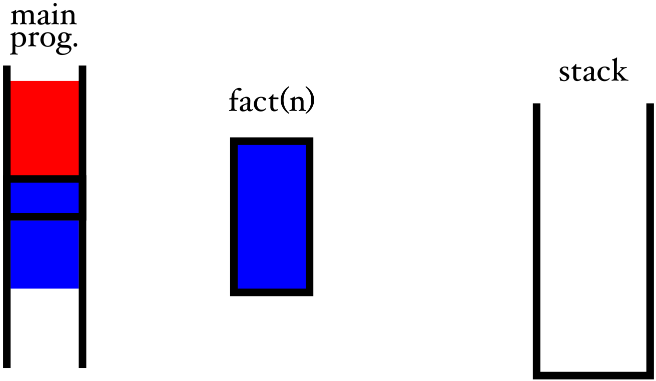



main
prog.
fact(n)
stack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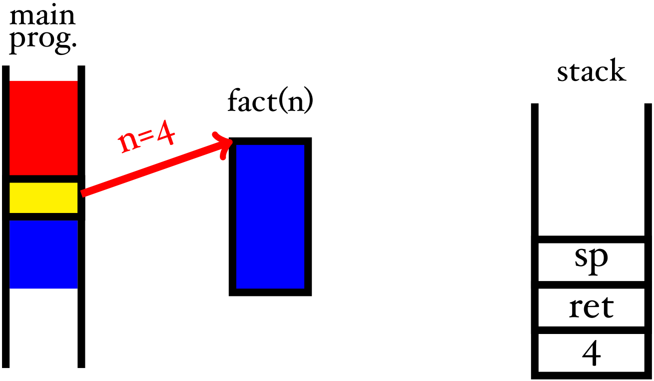
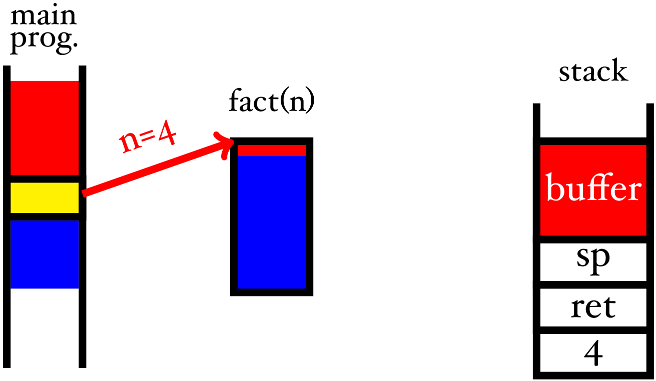

main
prog.
n=4
fact(n)
stack
sp
ret
4


main prog.
n=4
fact(n)
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buffer
sp
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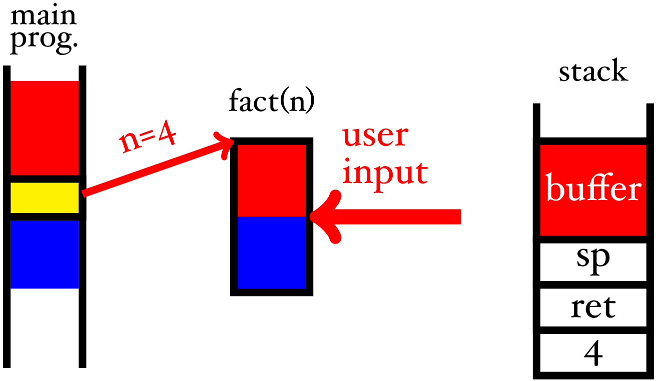
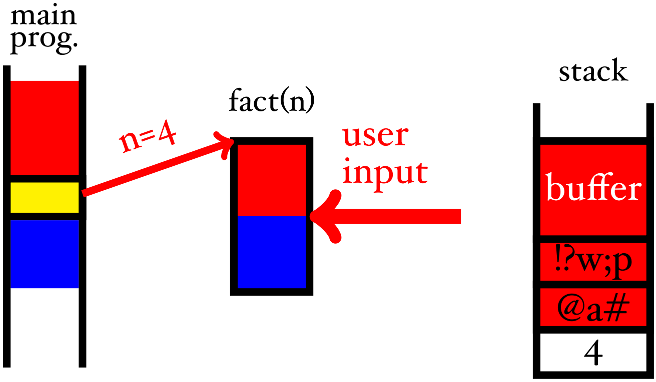
4


main
prog.
n=4
fact(n)
user
input
stack
buffer
sp
ret
4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stack
buffer
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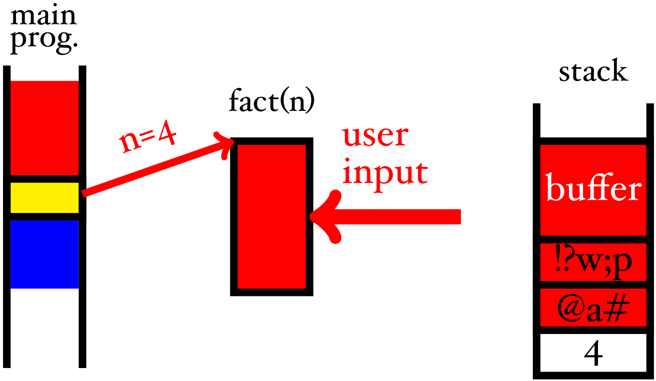
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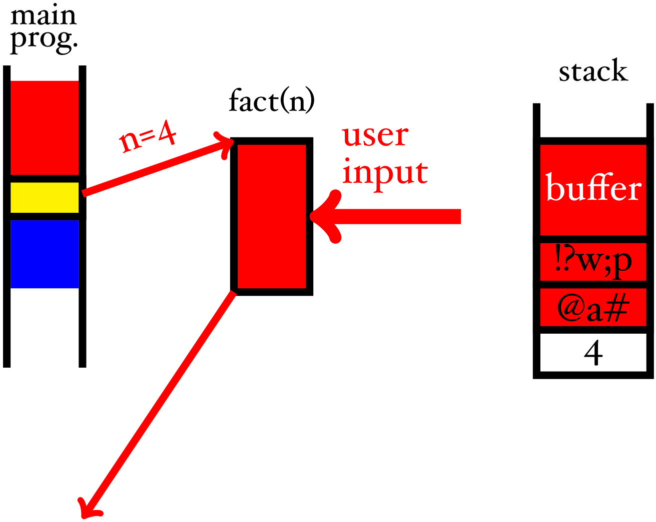
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