



Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

# Owning Stuff With Format Strings

deanx

Intercon II

13th June 2008



## Owning Stuff With Format Strings

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### outline

yin

what are they  
syntax

yang

what are they  
syntax

## 1 yin

- what are they
- syntax

## 2 yang

- what are they
- syntax



# what?

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

Format strings are a way of specifying the format when data is outputted



# what?

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

Format strings are a way of specifying the format when data is outputted

- dave is 20



# what?

## Owning Stuff With Format Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

Format strings are a way of specifying the format when data is outputted

- dave is 20
- %s is %d



# what?

## Owning Stuff With Format Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

Format strings are a way of specifying the format when data is outputted

- `dave is 20`
- `%s is %d`
- `printf(" %s is %d", name, age)`



# special characters

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With Format  
Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

These are used to format the output of variables



# special characters

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

These are used to format the output of variables

- %d - int





# special characters

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

These are used to format the output of variables

- %d - int
- %f - float



# special characters

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

These are used to format the output of variables

- %d - int
- %f - float
- %u - unsigned int



# special characters

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

These are used to format the output of variables

- %d - int
- %f - float
- %u - unsigned int
- %x - hex representation of an int



# special characters

Owning Stuff  
With Format  
Strings

deanx

outline

yin  
what are they  
syntax

yang  
what are they  
syntax

These are used to format the output of variables

- %d - int
- %f - float
- %u - unsigned int
- %x - hex representation of an int
- %s - string (prints till \x00)



# modifiers

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With Format  
Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

Used to more specifically control how variables are represented



# modifiers

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

Used to more specifically control how variables are represented

- `%.5f` - 3.14159



# modifiers

Owning Stuff  
With Format  
Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

Used to more specifically control how variables are represented

- `%.5f` - 3.14159
- `%#x` - 0xdeadbeaf



# modifiers

Owning Stuff  
With Format  
Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

Used to more specifically control how variables are represented

- `%.5f` - 3.14159
- `%#x` - 0xdeadbeaf
- `%4u` - xxxx4





# modifiers

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

Used to more specifically control how variables are represented

- `%.5f` - 3.14159
- `%#x` - 0xdeadbeaf
- `%4u` - xxxx4
- `%hx` - beaf



# modifiers

Owning Stuff  
With Format  
Strings

deanx

outline

yin  
what are they  
syntax

yang  
what are they  
syntax

Used to more specifically control how variables are represented

- `%.5f` - 3.14159
- `%#x` - 0xdeadbeaf
- `%4u` - xxxx4
- `%hx` - beaf
- `%hhx` - af



# modifiers 2

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With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

- dave is 20, dave is male



## modifiers 2

### Owning Stuff With Format Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

- dave is 20, dave is male
- %s is %d, %s is %s



## modifiers 2

### Owning Stuff With Format Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

- dave is 20, dave is male
- %s is %d, %s is %s
- printf(“ %s is %d, %s is %s”, name, age, name, sex)



## modifiers 2

### Owning Stuff With Format Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

- dave is 20, dave is male
- %s is %d, %s is %s
- printf(“ %s is %d, %s is %s”, name, age, name, sex)
- %1\$s



## modifiers 2

### Owning Stuff With Format Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

- dave is 20, dave is male
- %s is %d, %s is %s
- printf(“ %s is %d, %s is %s”, name, age, name, sex)
- %1\$s
- printf(“ %s is %d, %1\$s is %s”, name, age, sex)



# what

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

They can be misused if programmers forget about them





# what

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

They can be misused if programmers forget about them

- dave



# what

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

They can be misused if programmers forget about them

- `dave`
- `printf(name)`



# what

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

They can be misused if programmers forget about them

- `dave`
- `printf(name)`
- `%s`



# what

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

They can be misused if programmers forget about them

- dave
- `printf(name)`
- `%s`
- demo



# reading memory

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax



# reading memory

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

■ %0x













# reading memory

## Owning Stuff With Format Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

- `%x`
- `%x`
  - `aloadofcrap`
- `aaaa-%x%x%x%x%x%x%x%x%x%x%x`
  - `aaaa-aloadofcrap61616161morecrap`
- `aaaa-%8$#x`



# reading memory

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

- `%x`
- `%x`
  - `aloadofcrap`
- `aaaa-%x%x%x%x%x%x%x%x%x%x%x`
  - `aaaa-aloadofcrap61616161morecrap`
- `aaaa-%8$#x`
  - `aaaa-0x61616161`



# reading memory

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

- `%x`
- `%x`
  - `aloadofcrap`
- `aaaa-%x%x%x%x%x%x%x%x%x%x%x`
  - `aaaa-aloadofcrap61616161morecrap`
- `aaaa-%8$#x`
  - `aaaa-0x61616161`
- demo



# writing memory

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax



- Introducing `%n`



- Introducing %n
  - %n will write the number of bytes written to the pointer location specified





# writing memory

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

- Introducing %n
  - %n will write the number of bytes written to the pointer location specified
- dave has 4 characters in his name



- Introducing %n
  - %n will write the number of bytes written to the pointer location specified
- dave has 4 characters in his name
- `printf("%s%n has %d characters in his name", name, &chars, chars)`



# writing memory

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
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- Introducing %n
  - %n will write the number of bytes written to the pointer location specified
- dave has 4 characters in his name
- `printf("%s%n has %d characters in his name", name, &chars, chars)`
- `printf("%s%x has %d characters in his name", name, &chars, chars)`



# writing memory

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

- Introducing %n
  - %n will write the number of bytes written to the pointer location specified
- dave has 4 characters in his name
- `printf("%s%n has %d characters in his name", name, &chars, chars)`
- `printf("%s%x has %d characters in his name", name, &chars, chars)`
- demo



# controlling memory writes

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We want to overwrite 0xdeadbeef with 0x90909090



# controlling memory writes

Owning Stuff  
With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We want to overwrite 0xdeadbeef with 0x90909090

- We push 0xdeadbeef onto the stack as the first part of our FS



# controlling memory writes

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We want to overwrite 0xdeadbeef with 0x90909090

- We push 0xdeadbeef onto the stack as the first part of our FS
  - `\xef\xbe\xad\xde`



# controlling memory writes

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We want to overwrite 0xdeadbeef with 0x90909090

- We push 0xdeadbeef onto the stack as the first part of our FS
  - `\xef\xbe\xad\xde`
- We have now written 4 chars to the screen





# controlling memory writes

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We want to overwrite 0xdeadbeef with 0x90909090

- We push 0xdeadbeef onto the stack as the first part of our FS
  - `\xef\xbe\xad\xde`
- We have now written 4 chars to the screen
- So we know need to write another (90909090h-4) or



# controlling memory writes

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We want to overwrite 0xdeadbeef with 0x90909090

- We push 0xdeadbeef onto the stack as the first part of our FS
  - `\xef\xbe\xad\xde`
- We have now written 4 chars to the screen
- So we know need to write another (90909090h-4) or
- we use `%hn` or `%hhn` so we can write it in 2 or 1 byte sections



# controlling memory writes

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We want to overwrite 0xdeadbeef with 0x90909090

- We push 0xdeadbeef onto the stack as the first part of our FS
  - `\xef\xbe\xad\xde`
- We have now written 4 chars to the screen
- So we know need to write another (90909090h-4) or
- we use `%hn` or `%hhn` so we can write it in 2 or 1 byte sections
- Lets choose `%hn`, so 2 byte chunks.



# controlling memory writes

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We want to overwrite 0xdeadbeef with 0x90909090

- We push 0xdeadbeef onto the stack as the first part of our FS
  - `\xef\xbe\xad\xde`
- We have now written 4 chars to the screen
- So we know need to write another (90909090h-4) or
- we use `%hn` or `%hhn` so we can write it in 2 or 1 byte sections
- Lets choose `%hn`, so 2 byte chunks.
- So now we write



# controlling memory writes

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We want to overwrite 0xdeadbeef with 0x90909090

- We push 0xdeadbeef onto the stack as the first part of our FS
  - `\xef\xbe\xad\xde`
- We have now written 4 chars to the screen
- So we know need to write another (90909090h-4) or
- we use `%hn` or `%hhn` so we can write it in 2 or 1 byte sections
- Lets choose `%hn`, so 2 byte chunks.
- So now we write
  - 9090h (370008) to 0xdeadbeef



# controlling memory writes

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We want to overwrite 0xdeadbeef with 0x90909090

- We push 0xdeadbeef onto the stack as the first part of our FS
  - `\xef\xbe\xad\xde`
- We have now written 4 chars to the screen
- So we know need to write another (90909090h-4) or
- we use `%hn` or `%hhn` so we can write it in 2 or 1 byte sections
- Lets choose `%hn`, so 2 byte chunks.
- So now we write
  - 9090h (370008) to 0xdeadbeef
  - 9090h (370008) to 0xdeadbef1



# generating the FS

Owning Stuff  
With Format  
Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

We have a stack-pop length of 8 using 2x2 byte writes

- Push the addresses to the stack



# generating the FS

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We have a stack-pop length of 8 using 2x2 byte writes

- Push the addresses to the stack
  - `\xef\xbe\xad\xde\xf1\xbe\xad\xde`





# generating the FS

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We have a stack-pop length of 8 using 2x2 byte writes

- Push the addresses to the stack
  - `\xef\xbe\xad\xde\xf1\xbe\xad\xde`
- So now we have written 8 bytes so only another 37000 to go



# generating the FS

Owning Stuff  
With Format  
Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We have a stack-pop length of 8 using 2x2 byte writes

- Push the addresses to the stack
  - `\xef\xbe\xad\xde\xf1\xbe\xad\xde`
- So now we have written 8 bytes so only another 37000 to go
  - `%37000u` - simple



# generating the FS

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We have a stack-pop length of 8 using 2x2 byte writes

- Push the addresses to the stack
  - `\xef\xbe\xad\xde\xf1\xbe\xad\xde`
- So now we have written 8 bytes so only another 37000 to go
  - `%37000u` - simple
- `\xef\xbe\xad\xde\xf1\xbe\xad\xde%37000u`



# generating the FS

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We have a stack-pop length of 8 using 2x2 byte writes

- Push the addresses to the stack
  - `\xef\xbe\xad\xde\xf1\xbe\xad\xde`
- So now we have written 8 bytes so only another 37000 to go
  - `%37000u` - simple
- `\xef\xbe\xad\xde\xf1\xbe\xad\xde%37000u`
- now we use `%8$hn` and `%9$hn` to write the data



# generating the FS

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

We have a stack-pop length of 8 using 2x2 byte writes

- Push the addresses to the stack
  - `\xef\xbe\xad\xde\xf1\xbe\xad\xde`
- So now we have written 8 bytes so only another 37000 to go
  - `%37000u` - simple
- `\xef\xbe\xad\xde\xf1\xbe\xad\xde%37000u`
- now we use `%8$hn` and `%9$hn` to write the data
- `\xef\xbe\xad\xde\xf1\xbe\xad\xde%37000u%8$hn%9$hn`



# and finally

## Owning Stuff With Format Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

- very simple example



# and finally

## Owning Stuff With Format Strings

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outline

yin

what are they  
syntax

yang

what are they  
syntax

- very simple example
  - no nx
  - no ramdomised stack



# and finally

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

- very simple example
  - no nx
  - no ramdomised stack
- execute shell code from our buffer





# and finally

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

- very simple example
  - no nx
  - no ramdomised stack
- execute shell code from our buffer
- overwrite \$eip with location of shell code



# and finally

## Owning Stuff With Format Strings

deanx

outline

yin

what are they  
syntax

yang

what are they  
syntax

- very simple example
  - no nx
  - no ramdomised stack
- execute shell code from our buffer
- overwrite \$eip with location of shell code
- demo