CS 105

Week 14

Midterm 2 (*Multiple Choice Only*)

Median: 88.7%

Average: 90.0%

29 Perfect Scores!

Midterm 2

FR Grading in Progress
(Grades expected on Wednesday)

Data Gathered

Visualization Proposed

Presentation Due

Lab sections this week!

Final Project

Option 1: Present a d3 visualization of your data

Option 2: Present an Excel overview sheet of your data

Presentation

Quick, 2-3 minute overview of your data and your summary. *Only your XLSX or d3.js visualization.* No PPT.

SSL

SSL

Secure Sockets Layer

SSL

Secure Sockets Layer

TLS

Transport Layer Security


https://courses.engr.illinois.edu/cs105/

Page Info - https://courses.engr.illinois.edu/cs105/

General | Permissions | Security

Website Identity

Website: **courses.engr.illinois.edu**

Owner: **This website does not supply ownership information.**

Verified by: **Internet2**

View Certificate

Privacy & History

Have I visited this website prior to today? **Yes, 1,280 times**

Is this website storing information (cookies) on my computer? **Yes** View Cookies

Have I saved any passwords for this website? **No** View Saved Passwords

Technical Details

Connection Encrypted: High-grade Encryption (TLS_RSA_WITH_AES_128_CBC_SHA, 128 bit keys)

The page you are viewing was encrypted before being transmitted over the Internet.

Encryption makes it very difficult for unauthorized people to view information traveling between computers. It is therefore very unlikely that anyone read this page as it traveled across the network.

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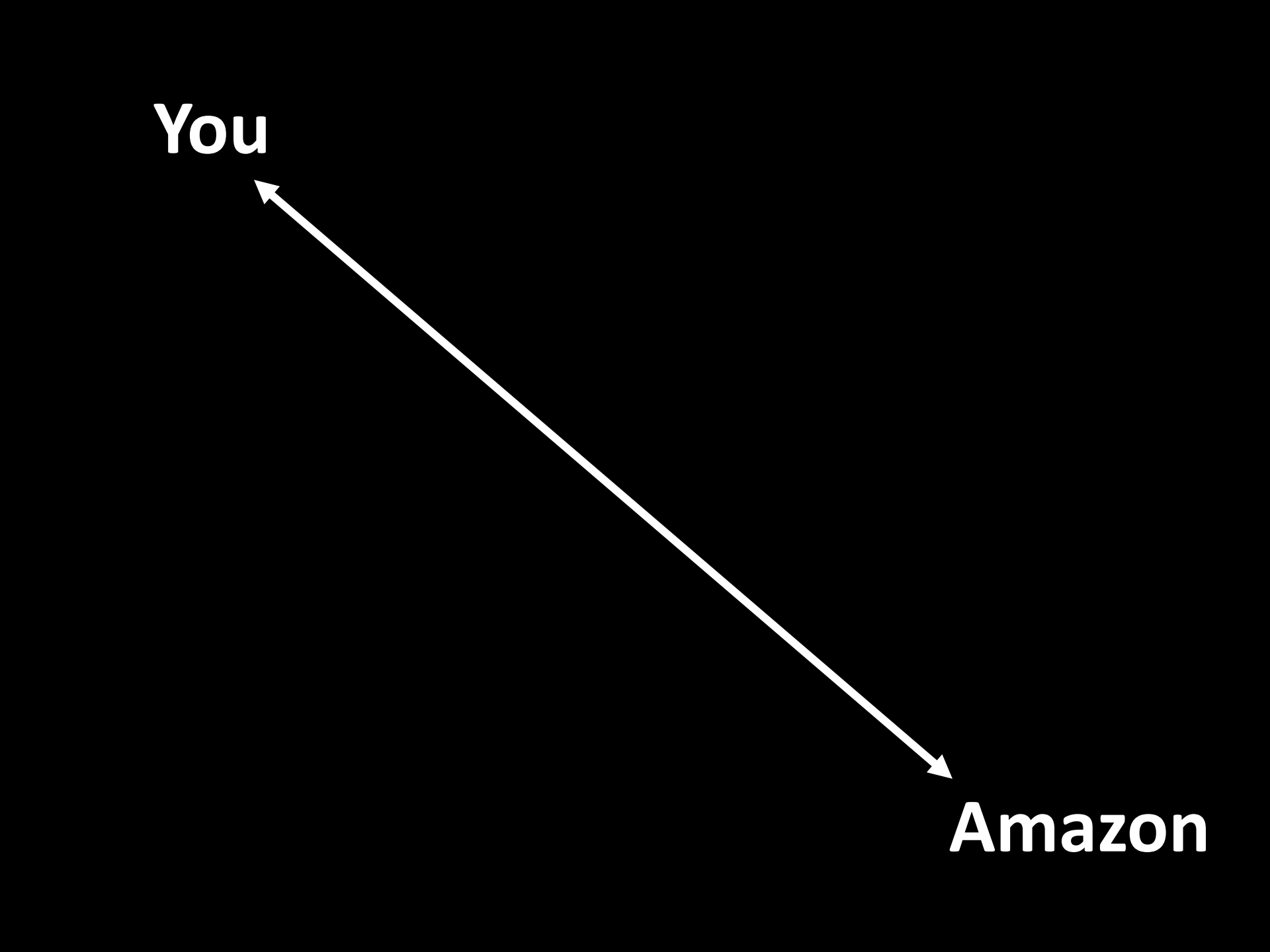
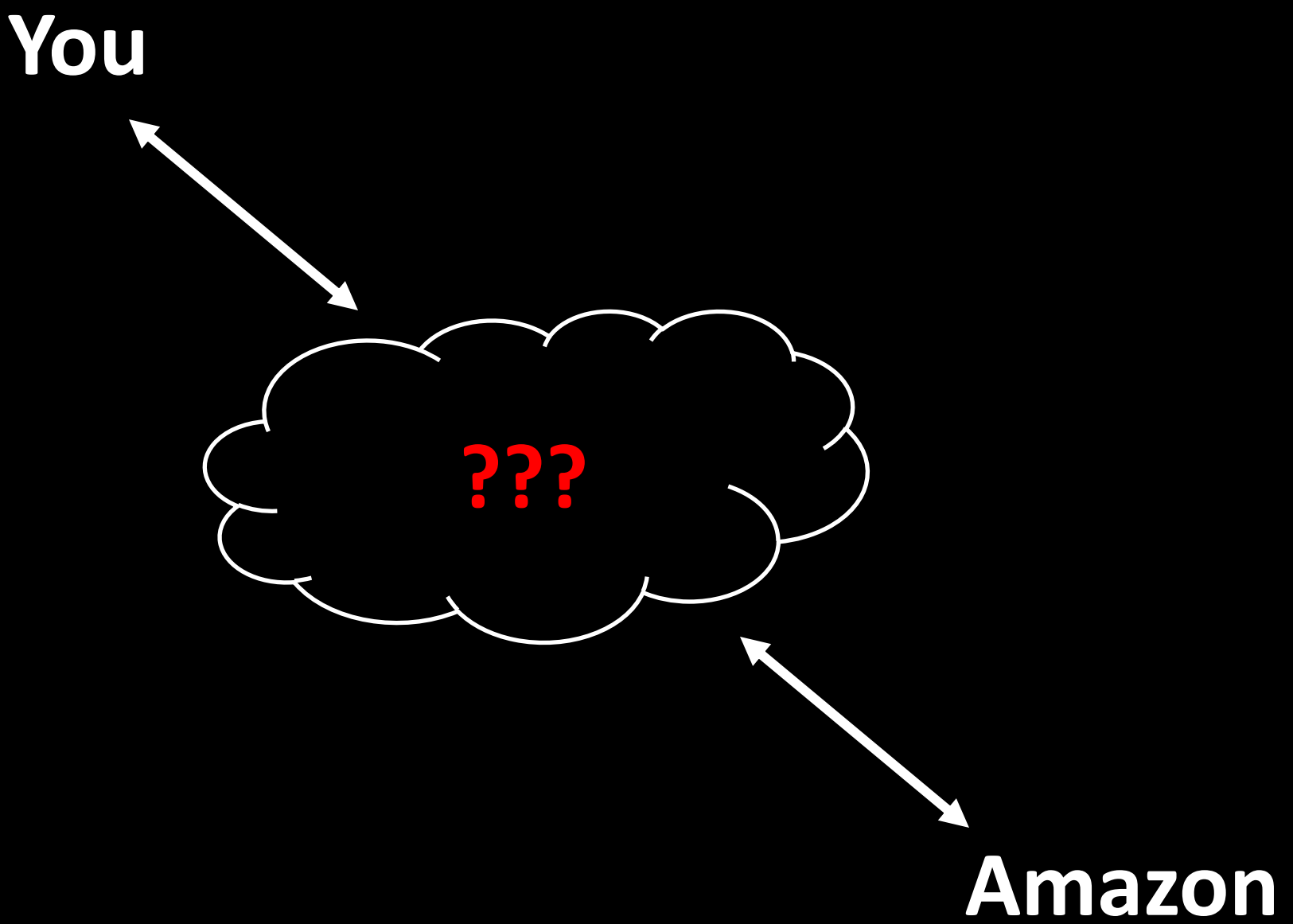
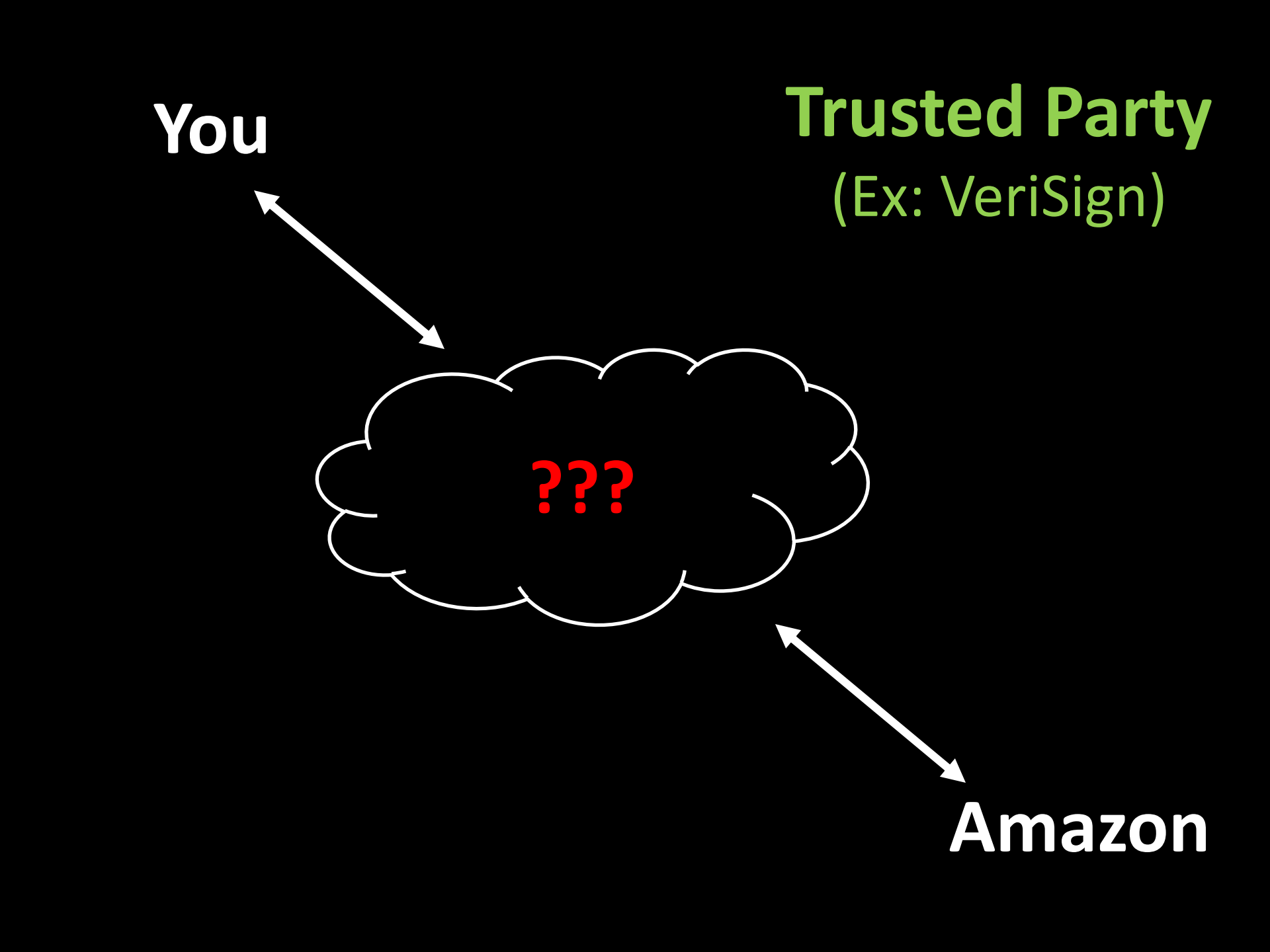
Identity


You
Amazon


You
???
Amazon


You
Trusted Party
(Ex: VeriSign)
???
Amazon

Trusted Party
(Ex: VeriSign)

Private Key

- **Kept completely private**
- **Required to sign a certificate**

Trusted Party
(Ex: VeriSign)

Private Key

- Kept completely private
- Required to sign a certificate

Public Key

- Known by everyone
- Can be used to validate that a signature is authentic

Trusted Party
(Ex: VeriSign)

verifies the identity of Amazon

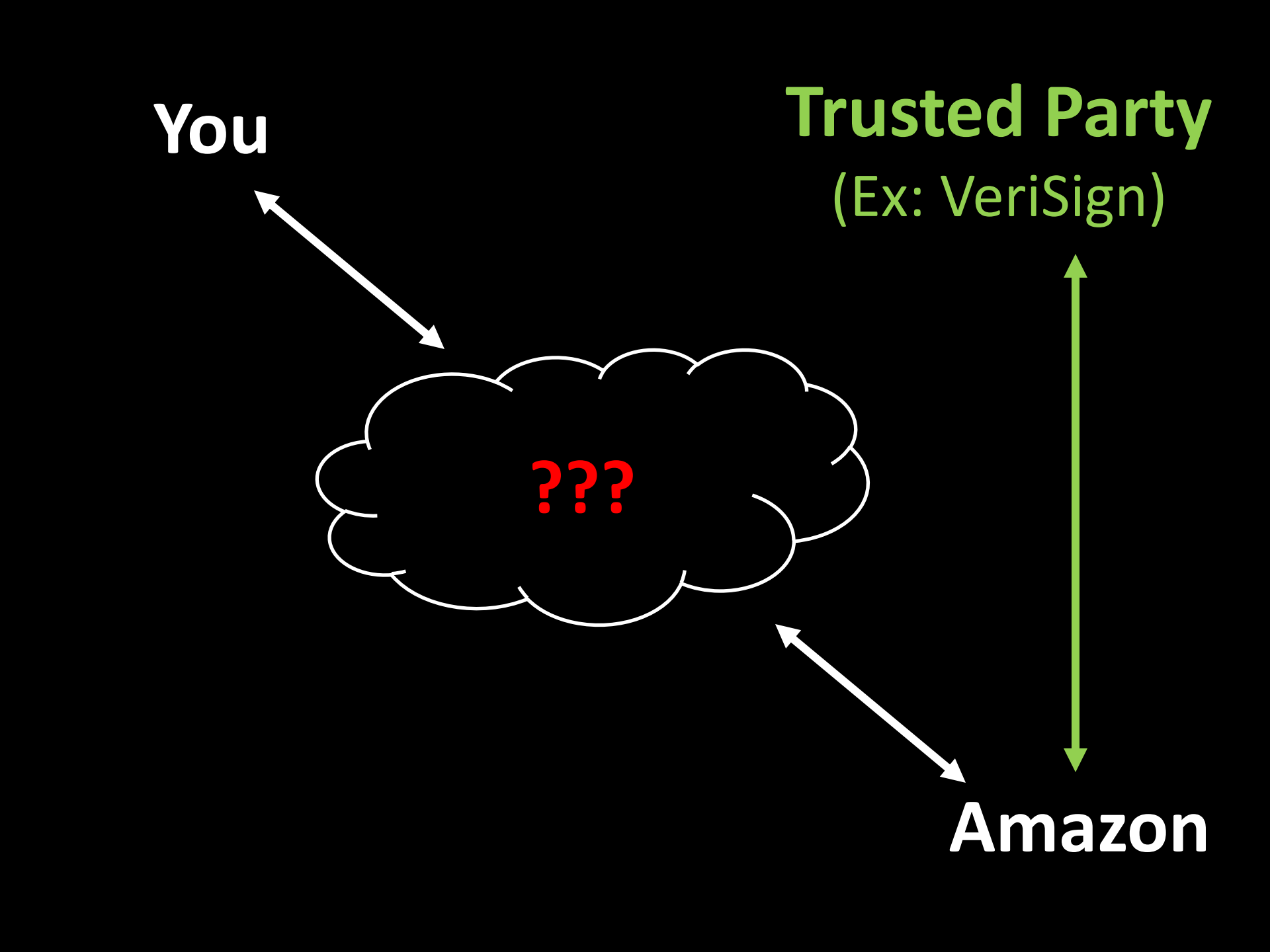
Amazon

Trusted Party
(Ex: VeriSign)

verifies the identity of Amazon

sign w/ private key

Amazon


You
Trusted Party
(Ex: VeriSign)
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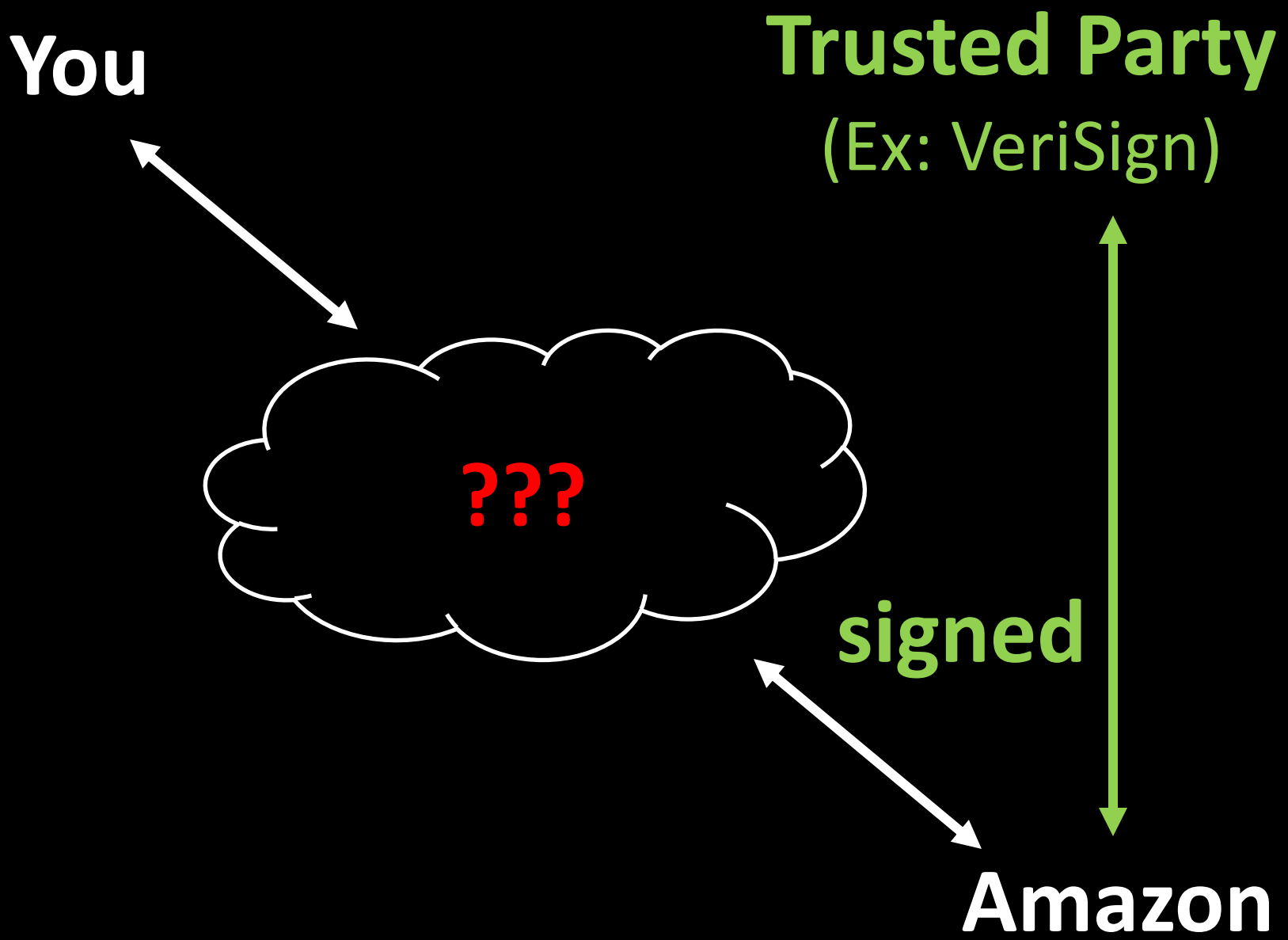
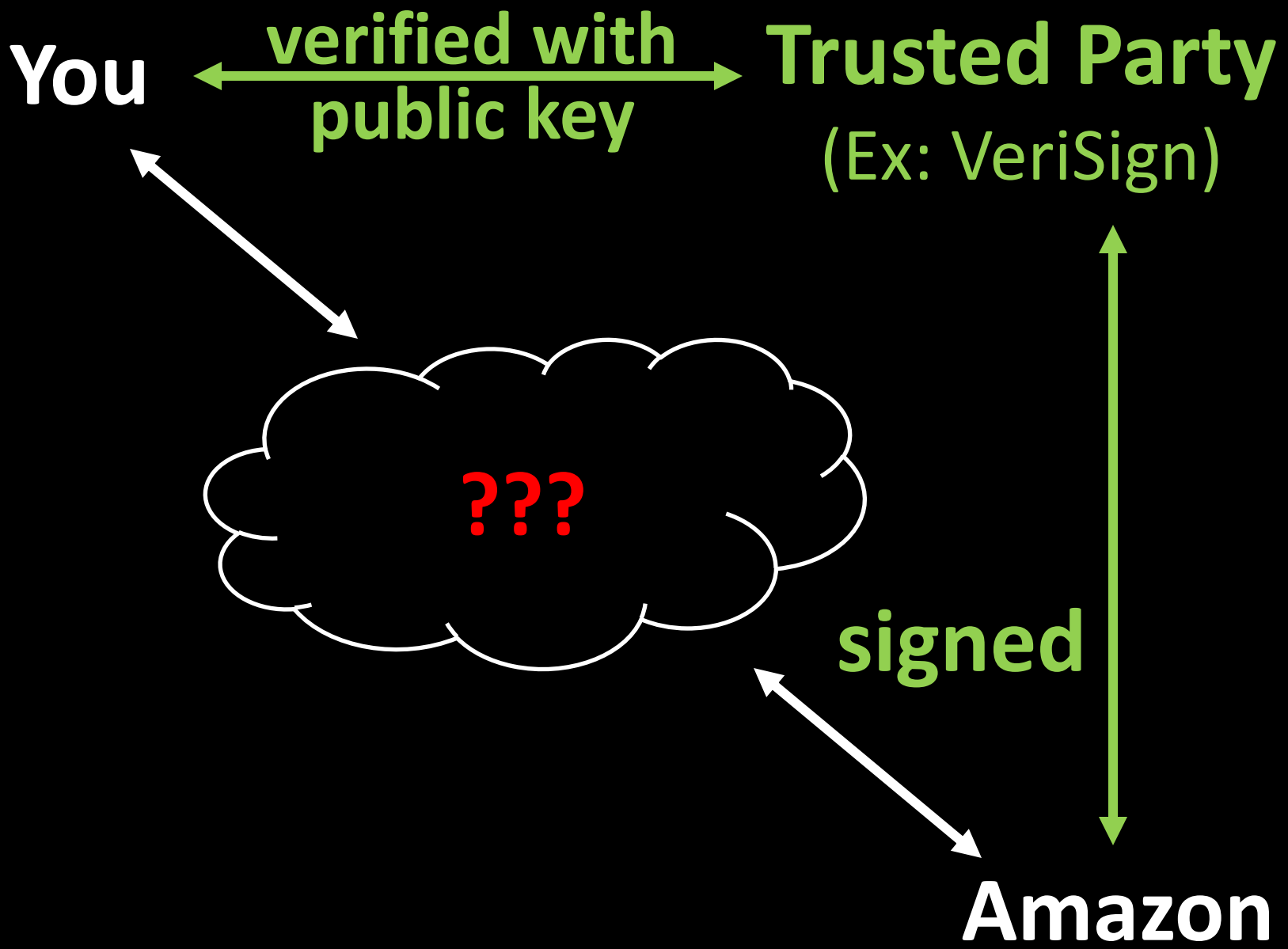
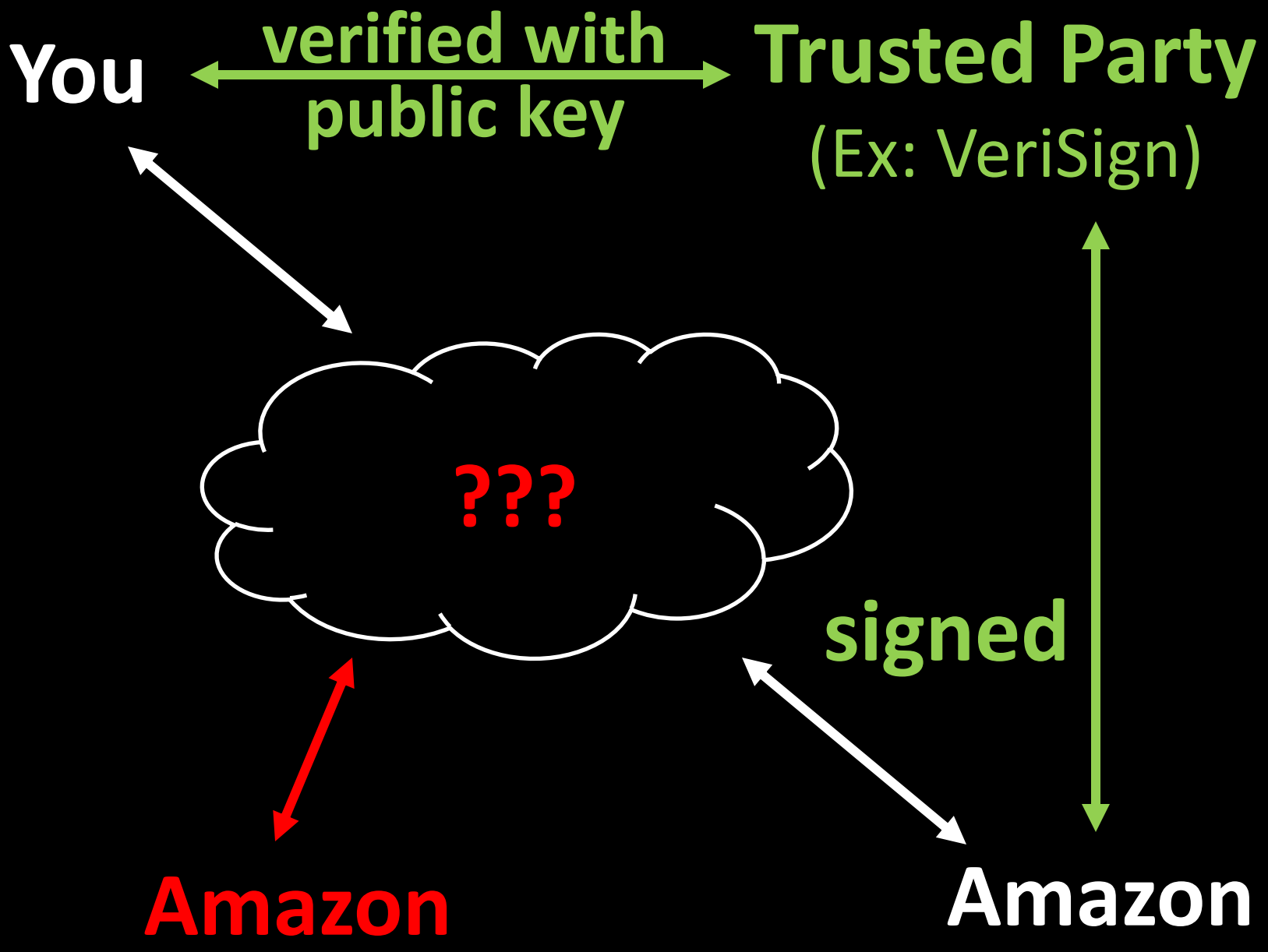
Amazon


You
Trusted Party
(Ex: VeriSign)
???
signed
Amazon


You
verified with
public key
Trusted Party
(Ex: VeriSign)
???
signed
Amazon


You
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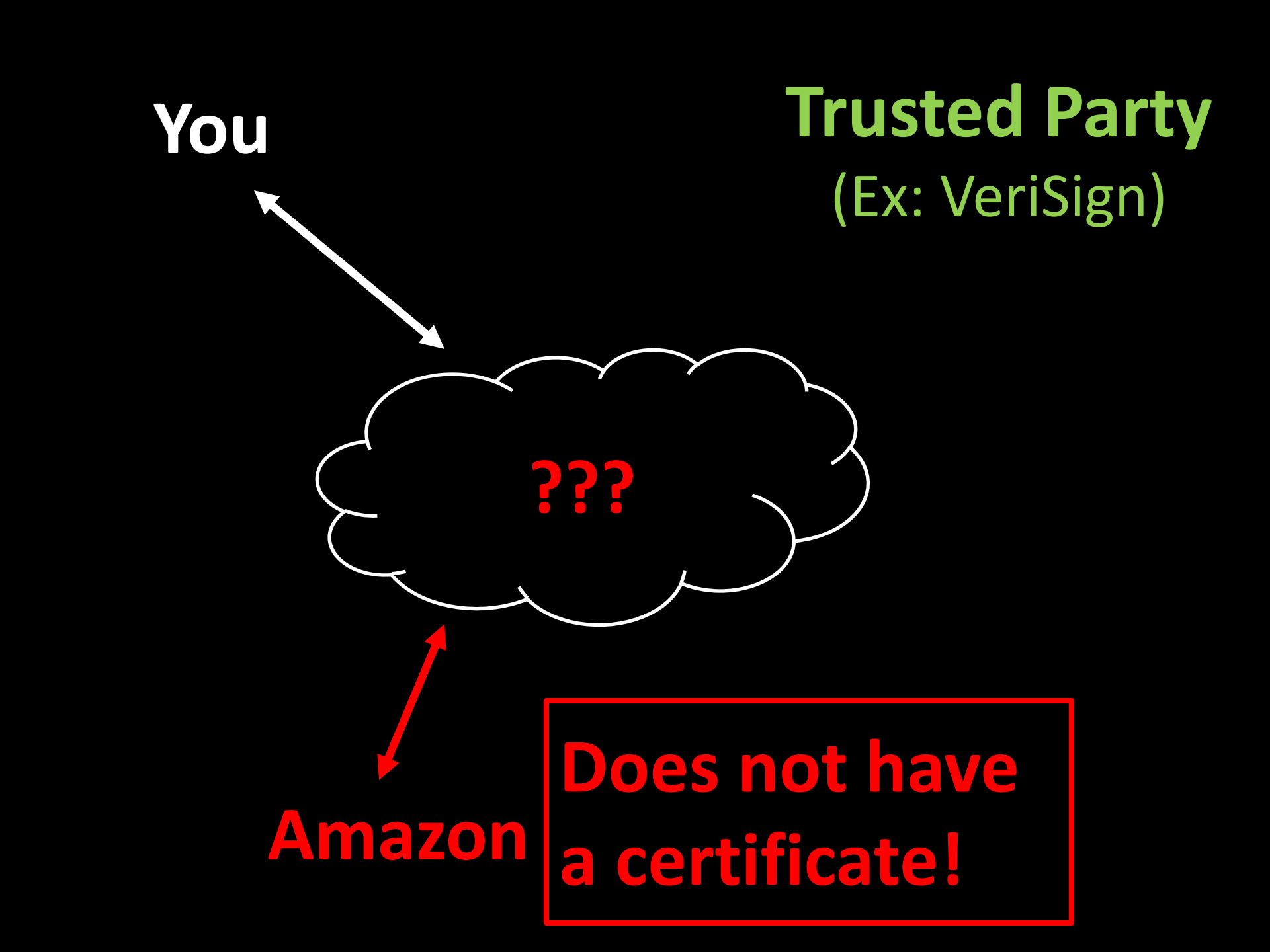
You
Trusted Party
(Ex: VeriSign)
???
Amazon
Does not have a certificate!

Can evil Amazon claim to be real Amazon?

- Option 1: Convince the trusted party that they are really Amazon

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- Option 2: Forge a fake signature

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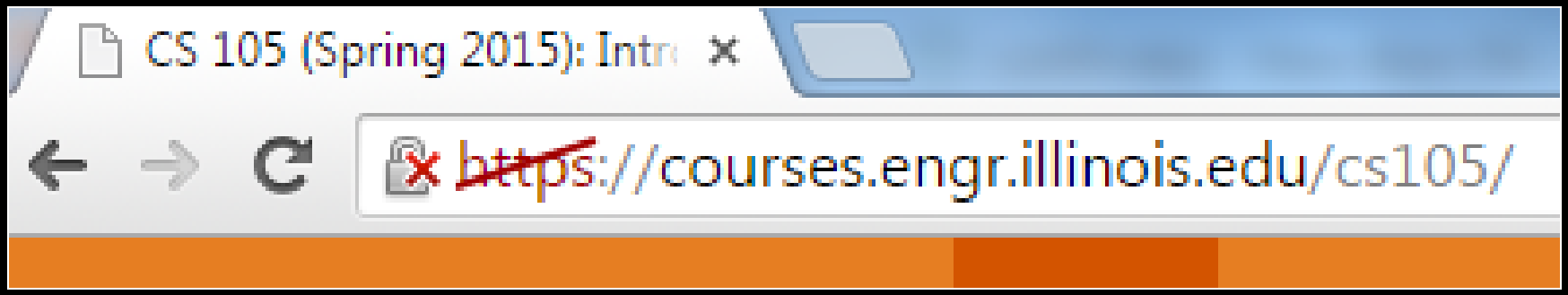
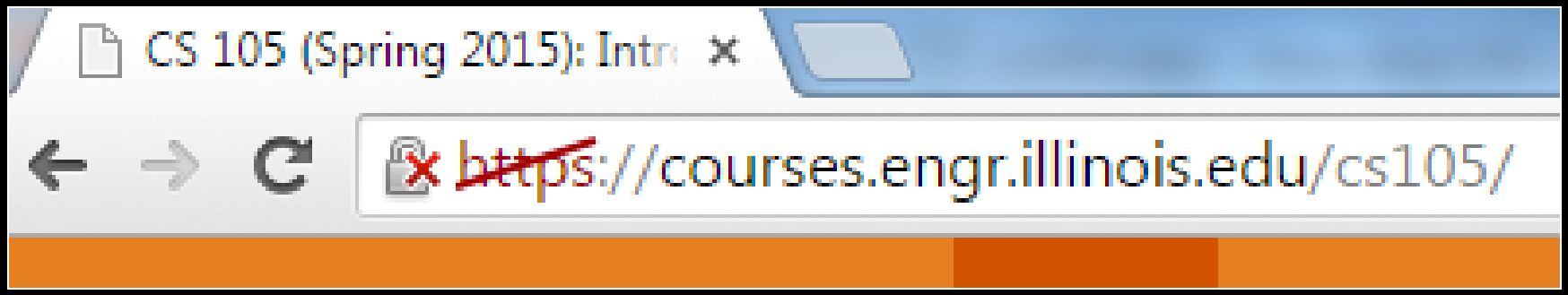
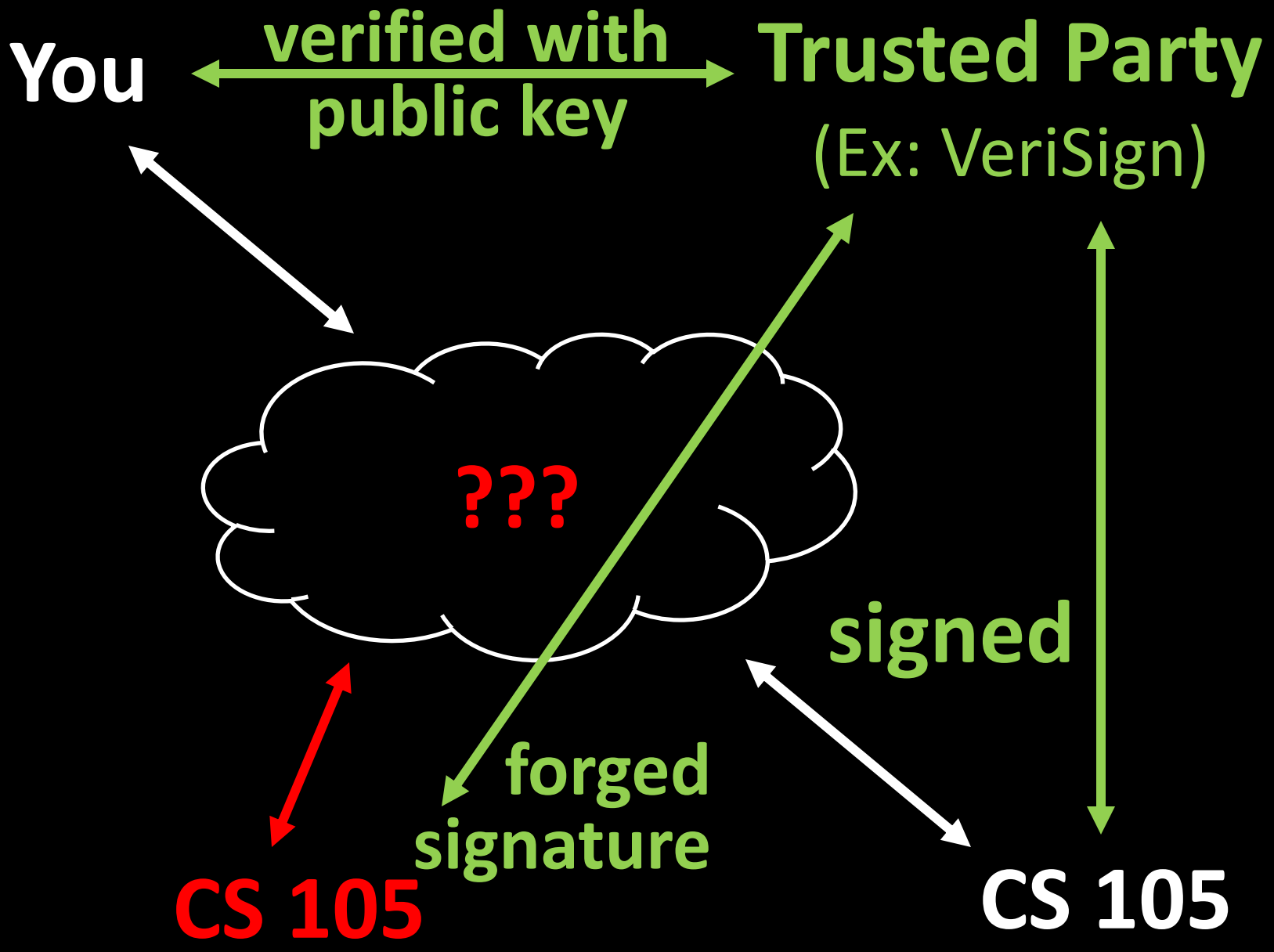




courses.engr.illinois.edu uses a certificate that, as of April 2015, Google feels might be able to be faked


You
verified with
public key
Trusted Party
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???
signed
forged
signature
CS 105
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“Identity”

Ensures the website is who it says it is (and not someone else)

“Security”

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```
9b 68 6c 11 7e 55 71 82 cd 20 58 78 2d 15 0f 09
5d 04 05 56 ea d2 3b 3b 12 a7 eb fd 23 3a c3 fb
c8 01 98 2b 32 06 72 2c 12 f9 0d ee 1c 01 02 23
40 a5 1a d7 ec 56 02 72 13 38 69 41 05 22 64 8a
4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
f7 ef 17 50 05 be ff 2f 47 7e 99 26 19 c7 7c b7
6a b4 ac 35 c2 91 fc 2d 26 ad d3 63 76 de 3c 09
6b 8d 94 4c 9b 6a 24 1b 03 8c 3b c3 10 67 65 ca
03 b1 a2 25 3c 1c 2a 90 7e 49 e4 45 67 b2 5a 54
34 97 6e 1b 7b 5f c4 d1 b1 a5 1a d6 a5 67 6e ca
1e 6f b9 85 ff 3c 44 2b cd d6 f8 ea f9 d3 46 de
8f bd dd d9 36 fd 50 81 fb 71 72 b0 62 47 6c 91
bd 6e bd 3f be 54 2f c9 ec 51 16 5e c3 77 44 a3
40 63 3e b6 38 7f 81 a0 50 7f 81 d3 a5 7b 7c 1f
a6 09 9f a1 e9 62 44 d0 f8 83 28 9a ae be 3f 03
51 8c 67 51 f9 5b 3a 68 2c 37 9a b3 1c 49 4f 9b
```

0 → 0000	8 → 1000
1 → 0001	9 → 1001
2 → 0010	a → 1010
3 → 0011	b → 1011
4 → 0100	c → 1100
5 → 0101	d → 1101
6 → 0110	e → 1110
7 → 0111	f → 1111

```
1001b 68 6c 11 7e 55 71 82 cd 20 58 78 2d 15 0f 09
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  40 a5 1a d7 ec 56 02 72 13 38 69 41 05 22 64 8a
  4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
  f7 ef 17 50 05 be ff 2f 47 7e 99 26 19 c7 7c b7
  6a b4 ac 35 c2 91 fc 2d 26 ad d3 63 76 de 3c 09
  6b 8d 94 4c 9b 6a 24 1b 03 8c 3b c3 10 67 65 ca
  03 b1 a2 25 3c 1c 2a 90 7e 49 e4 45 67 b2 5a 54
  34 97 6e 1b 7b 5f c4 d1 b1 a5 1a d6 a5 67 6e ca
  1e 6f b9 85 ff 3c 44 2b cd d6 f8 ea f9 d3 46 de
  8f bd dd d9 36 fd 50 81 fb 71 72 b0 62 47 6c 91
 bd 6e bd 3f be 54 2f c9 ec 51 16 5e c3 77 44 a3
  40 63 3e b6 38 7f 81 a0 50 7f 81 d3 a5 7b 7c 1f
  a6 09 9f a1 e9 62 44 d0 f8 83 28 9a ae be 3f 03
  51 8c 67 51 f9 5b 3a 68 2c 37 9a b3 1c 49 4f 9b
```
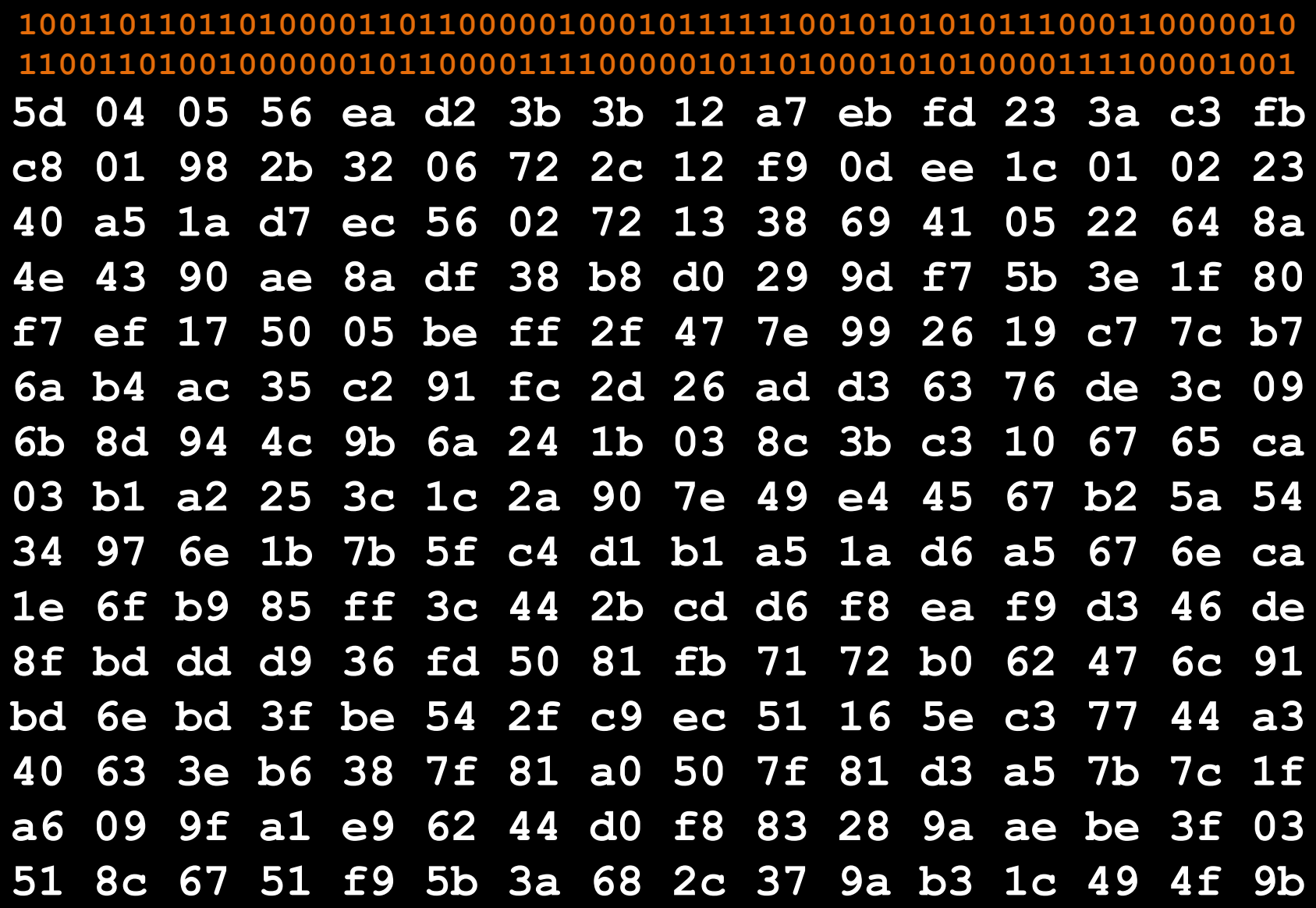
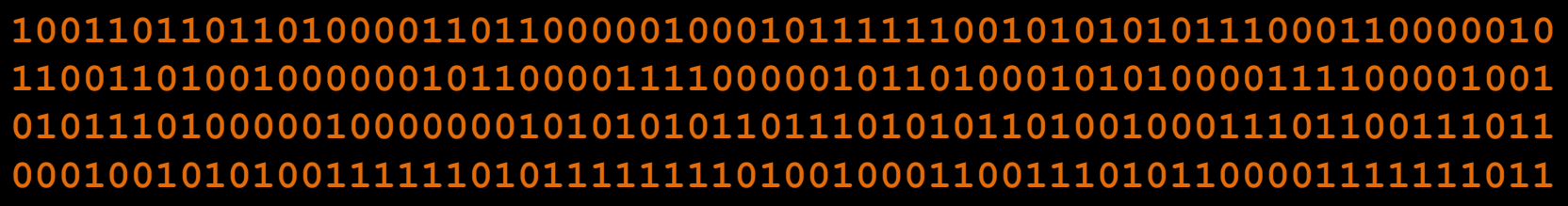


10011011011010000110110000010001011111100101010101110001100000101100110100100000010110000111100000101101000101010000111100001001
5d 04 05 56 ea d2 3b 3b 12 a7 eb fd 23 3a c3 fb
c8 01 98 2b 32 06 72 2c 12 f9 0d ee 1c 01 02 23
40 a5 1a d7 ec 56 02 72 13 38 69 41 05 22 64 8a
4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
f7 ef 17 50 05 be ff 2f 47 7e 99 26 19 c7 7c b7
6a b4 ac 35 c2 91 fc 2d 26 ad d3 63 76 de 3c 09
6b 8d 94 4c 9b 6a 24 1b 03 8c 3b c3 10 67 65 ca
03 b1 a2 25 3c 1c 2a 90 7e 49 e4 45 67 b2 5a 54
34 97 6e 1b 7b 5f c4 d1 b1 a5 1a d6 a5 67 6e ca
1e 6f b9 85 ff 3c 44 2b cd d6 f8 ea f9 d3 46 de
8f bd dd d9 36 fd 50 81 fb 71 72 b0 62 47 6c 91
bd 6e bd 3f be 54 2f c9 ec 51 16 5e c3 77 44 a3
40 63 3e b6 38 7f 81 a0 50 7f 81 d3 a5 7b 7c 1f
a6 09 9f a1 e9 62 44 d0 f8 83 28 9a ae be 3f 03
51 8c 67 51 f9 5b 3a 68 2c 37 9a b3 1c 49 4f 9b

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4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
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1e 6f b9 85 ff 3c 44 2b cd d6 f8 ea f9 d3 46 de
8f bd dd d9 36 fd 50 81 fb 71 72 b0 62 47 6c 91
bd 6e bd 3f be 54 2f c9 ec 51 16 5e c3 77 44 a3
40 63 3e b6 38 7f 81 a0 50 7f 81 d3 a5 7b 7c 1f
a6 09 9f a1 e9 62 44 d0 f8 83 28 9a ae be 3f 03
51 8c 67 51 f9 5b 3a 68 2c 37 9a b3 1c 49 4f 9b
```


2048 bits


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You

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6a b4 ac 35 c2 91 fc 2d 26 ad d3 63 76 de 3c 09
6b 8d 94 4c 9b 6a 24 1b 03 8c 3b c3 10 67 65 ca
03 b1 a2 25 3c 1c 2a 90 7e 49 e4
34 97 6e 1b 7b 5f c4 d1 b1 a5 1a
1e 6f b9 85 ff 3c 44 2b cd d6 f8
8f bd dd d9 36 fd 50 81 fb 71 72
bd 6e bd 3f be 54 2f c9 ec 51 16
40 63 3e b6 38 7f 81 a0 50 7f 81
a6 09 9f a1 e9 62 44 d0 f8 83 28
51 8c 67 51 f9 5b 3a 68 2c 37 9a
```

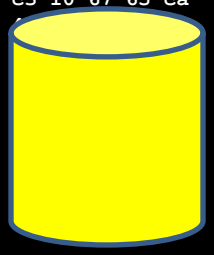

Amazon

You

```
9b 68 6c 11 7e 55 71 82 cd 20 58 78 2d 15 0f 09
5d 04 05 56 ea d2 3b 3b 12 a7 eb fd 23 3a c3 fb
c8 01 98 2b 32 06 72 2c 12 f9 0d ee 1c 01 02 23
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8f bd dd d9 36 fd 50 81 fb 71 72
bd 6e bd 3f be 54 2f c9 ec 51 16
40 63 3e b6 38 7f 81 a0 50 7f 81
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51 8c 67 51 f9 5b 3a 68 2c 37 9a
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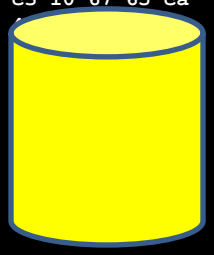

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4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
f7 ef 17 50 05 be ff 2f 47 7e 99 26 19 c7 7c b7
6a b4 ac 35 c2 91 fc 2d 26 ad d3 63 76 de 3c 09
6b 8d 94 4c 9b 6a 24 1b 03 8c 3b c3 10 67 65 ca
03 b1 a2 25 3c 1c 2a 90 7e 49 e4
34 97 6e 1b 7b 5f c4 d1 b1 a5 1a
1e 6f b9 85 ff 3c 44 2b cd d6 f8
8f bd dd d9 36 fd 50 81 fb 71 72
bd 6e bd 3f be 54 2f c9 ec 51 16
40 63 3e b6 38 7f 81 a0 50 7f 81
a6 09 9f a1 e9 62 44 d0 f8 83 28
51 8c 67 51 f9 5b 3a 68 2c 37 9a
```

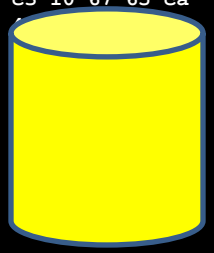

Amazon

You

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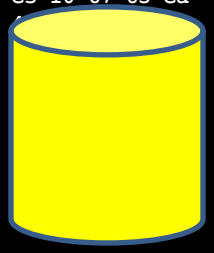
9b 68 6c 11 7e 55 71 82 cd 20 58 78 2d 15 0f 09
5d 04 05 56 ea d2 3b 3b 12 a7 eb fd 23 3a c3 fb
c8 01 98 2b 32 06 72 2c 12 f9 0d ee 1c 01 02 23
40 a5 1a d7 ec 56 02 72 13 38 69 41 05 22 64 8a
4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
f7 ef 17 50 05 be ff 2f 47 7e 99 26 19 c7 7c b7
6a b4 ac 35 c2 91 fc 2d 26 ad d3 63 76 de 3c 09
6b 8d 94 4c 9b 6a 24 1b 03 8c 3b c3 10 67 65 ca
03 b1 a2 25 3c 1c 2a 90 7e 49 e4
34 97 6e 1b 7b 5f c4 d1 b1 a5 1a
1e 6f b9 85 ff 3c 44 2b cd d6 f8
8f bd dd d9 36 fd 50 81 fb 71 72
bd 6e bd 3f be 54 2f c9 ec 51 16
40 63 3e b6 38 7f 81 a0 50 7f 81
a6 09 9f a1 e9 62 44 d0 f8 83 28
51 8c 67 51 f9 5b 3a 68 2c 37 9a
```



Amazon

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5d 04 05 56 ea d2 3b 3b 12 a7 eb fd 23 3a c3 fb
c8 01 98 2b 32 06 72 2c 12 f9 0d ee 1c 01 02 23
40 a5 1a d7 ec 56 02 72 13 38 69 41 05 22 64 8a
4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
f7 ef 17 50 05 be ff 2f 47 7e 99 26 19 c7 7c b7
6a b4 ac 35 c2 91 fc 2d 26 ad d3 63 76 de 3c 09
6b 8d 94 4c 9b 6a 24 1b 03 8c 3b c3 10 67 65 ca
03 b1 a2 25 3c 1c 2a 90 7e 49 e4
34 97 6e 1b 7b 5f c4 d1 b1 a5 1a
1e 6f b9 85 ff 3c 44 2b cd d6 f8
8f bd dd d9 36 fd 50 81 fb 71 72
bd 6e bd 3f be 54 2f c9 ec 51 16
40 63 3e b6 38 7f 81 a0 50 7f 81
a6 09 9f a1 e9 62 44 d0 f8 83 28
51 8c 67 51 f9 5b 3a 68 2c 37 9a
```
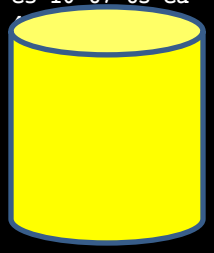
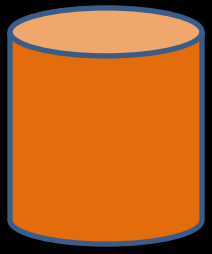



Amazon

You

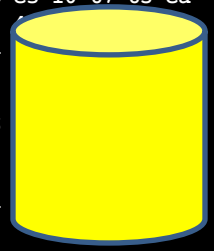


+

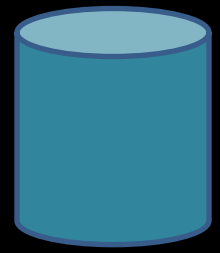
Your secret

=

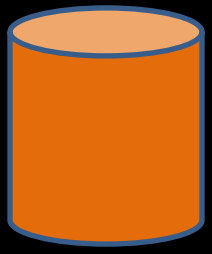
```
9b 68 6c 11 7e 55 71 82 cd 20 58 78 2d 15 0f 09
5d 04 05 56 ea d2 3b 3b 12 a7 eb fd 23 3a c3 fb
c8 01 98 2b 32 06 72 2c 12 f9 0d ee 1c 01 02 23
40 a5 1a d7 ec 56 02 72 13 38 69 41 05 22 64 8a
4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
f7 ef 17 50 05 be ff 2f 47 7e 99 26 19 c7 7c b7
6a b4 ac 35 c2 91 fc 2d 26 ad d3 63 76 de 3c 09
6b 8d 94 4c 9b 6a 24 1b 03 8c 3b c3 10 67 65 ca
03 b1 a2 25 3c 1c 2a 90 7e 49 e4
34 97 6e 1b 7b 5f c4 d1 b1 a5 1a
1e 6f b9 85 ff 3c 44 2b cd d6 f8
8f bd dd d9 36 fd 50 81 fb 71 72
bd 6e bd 3f be 54 2f c9 ec 51 16
40 63 3e b6 38 7f 81 a0 50 7f 81
a6 09 9f a1 e9 62 44 d0 f8 83 28
51 8c 67 51 f9 5b 3a 68 2c 37 9a
```



Amazon



You



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Your secret

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40 a5 1a d7 ec 56 02 72 13 38 69 41 05 22 64 8a
4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
f7 ef 17 50 05 be ff 2f 47 7e 99 26 19 c7 7c b7
6a b4 ac 35 c2 91 fc 2d 26 ad d3 63 76 de 3c 09
6b 8d 94 4c 9b 6a 24 1b 03 8c 3b c3 10 67 65 ca
03 b1 a2 25 3c 1c 2a 90 7e 49 e4
34 97 6e 1b 7b 5f c4 d1 b1 a5 1a
1e 6f b9 85 ff 3c 44 2b cd d6 f8
8f bd dd d9 36 fd 50 81 fb 71 72
bd 6e bd 3f be 54 2f c9 ec 51 16
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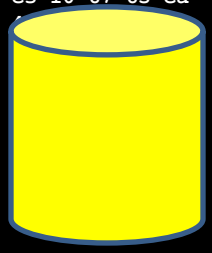

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Amazon

Amazon secret

You

Amazon

```
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40 a5 1a d7 ec 56 02 72 13 38 69 41 05 22 64 8a
4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
f7 ef 17 50 05 be ff 2f 47 7e 99 26 19 c7 7c b7
6a b4 ac 35 c2 91 fc 2d 26 ad d3 63 76 de 3c 09
6b 8d 94 4c 9b 6a 24 1b 03 8c 3b c3 10 67 65 ca
03 b1 a2 25 3c 1c 2a 90 7e 49 e4 45 67 b2 5a 54
34 97 6e 1b 7b 5f c4 d1 b1 a5 1a d6 a5 67 6e ca
1e 6f b9 85 ff 3c 44 2b cd d6 f8 ea f9 d3 46 de
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bd 6e bd 3f be 54 2f c9 ec 51 16 5e c3 77 44 a3
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a6 09 9f a1 e9 62 44 d0 f8 83 28 9a ae be 3f 03
51 8c 67 51 f9 5b 3a 68 2c 37 9a b3 1c 49 4f 9b
```

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Your secret

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Amazon secret

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You

Amazon

```
9b 68 6c 11 7e 55 71 82 cd 20 58 78 2d 15 0f 09
5d 04 05 56 ea d2 3b 3b 12 a7 eb fd 23 3a c3 fb
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40 a5 1a d7 ec 56 02 72 13 38 69 41 05 22 64 8a
4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
f7 ef 17 50 05 be ff 2f 47 7e 99 26 19 c7 7c b7
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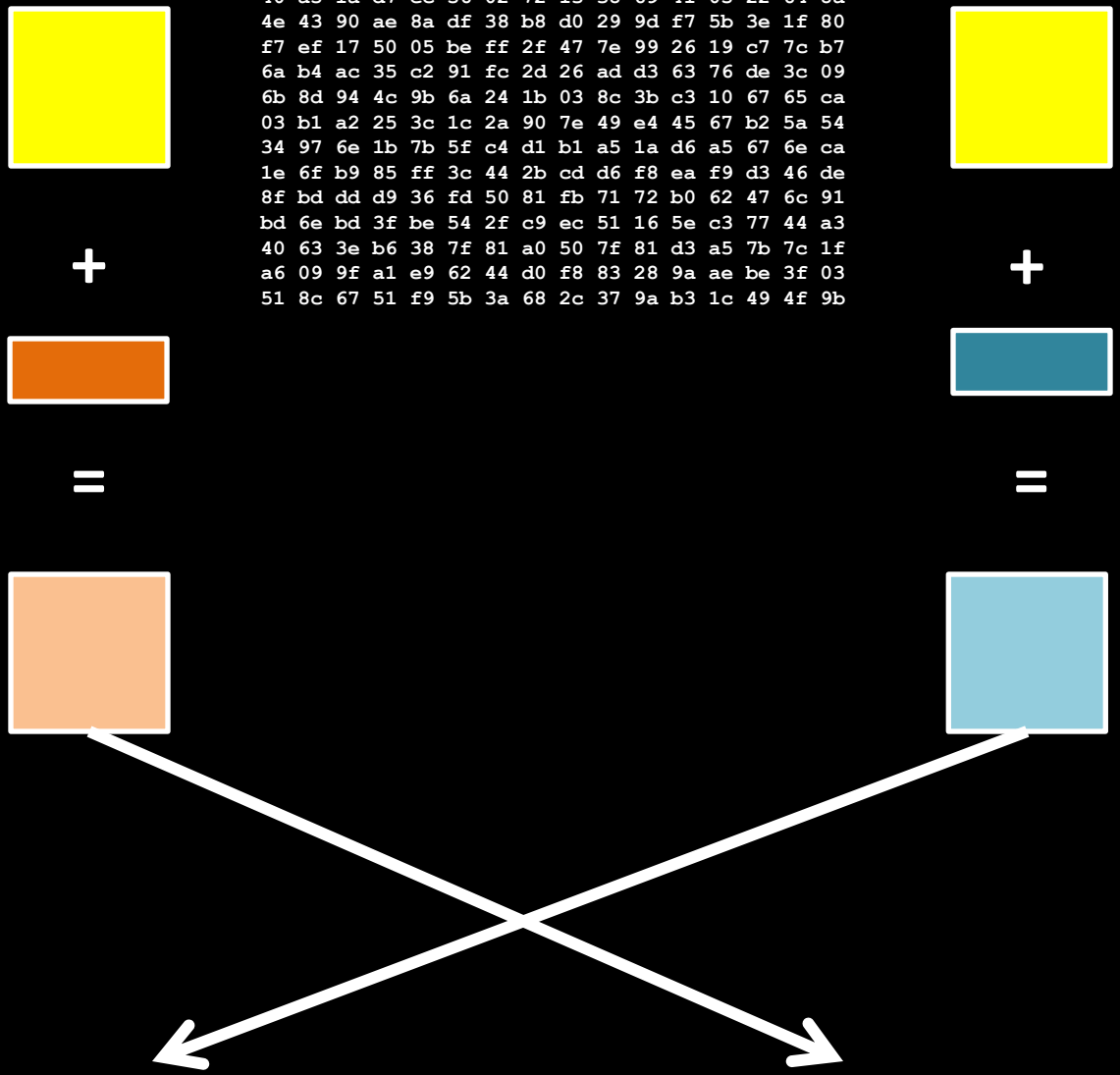
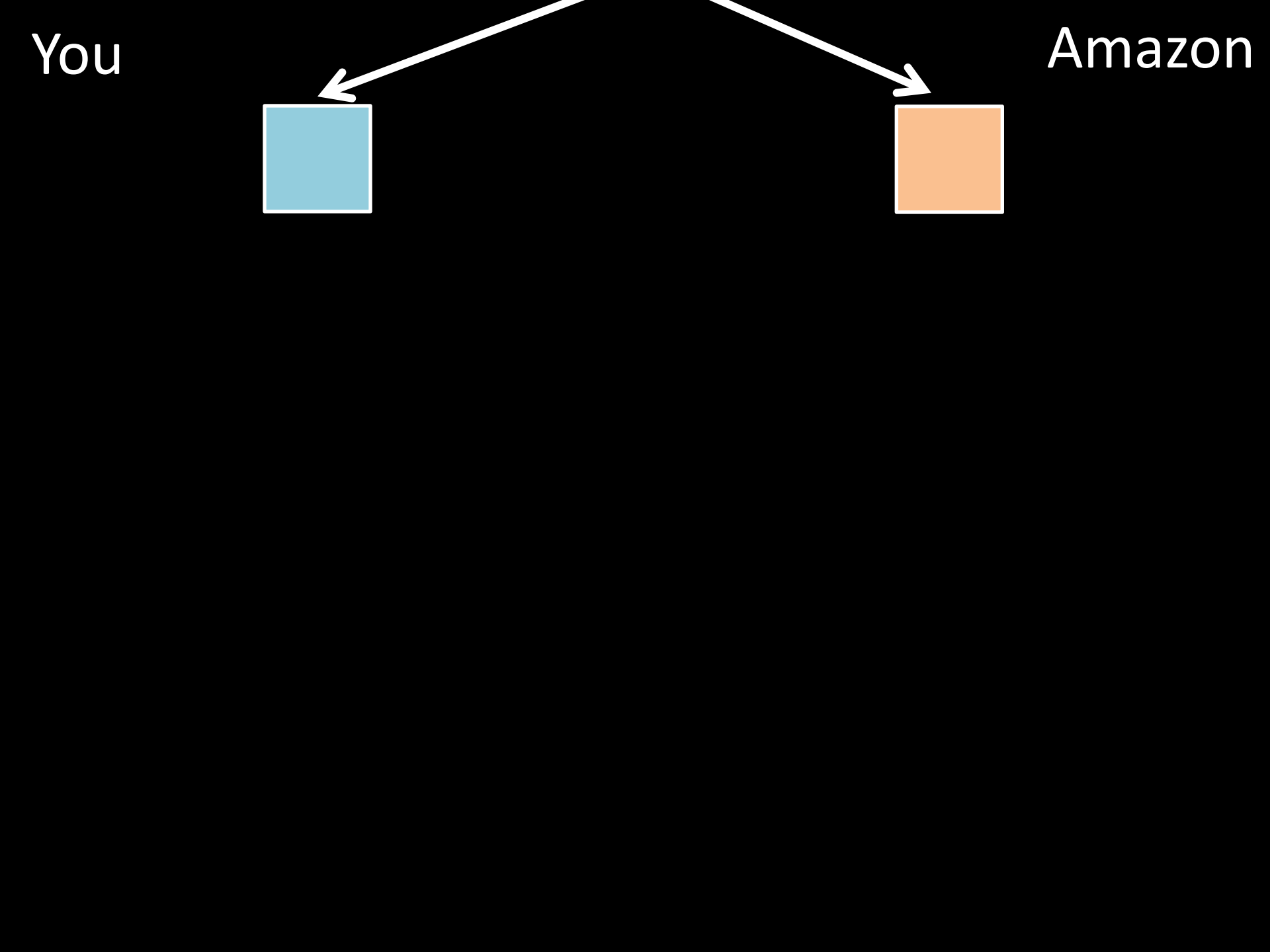


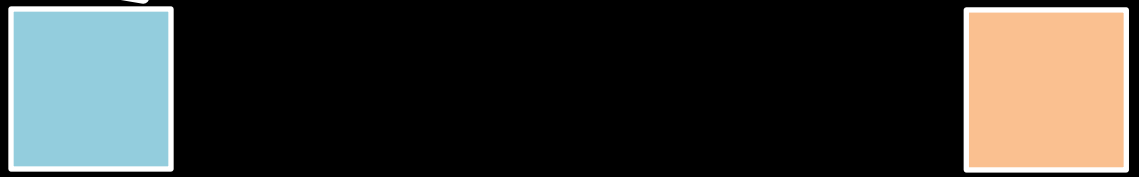
Your secret

Amazon secret


You
Amazon

You

Amazon



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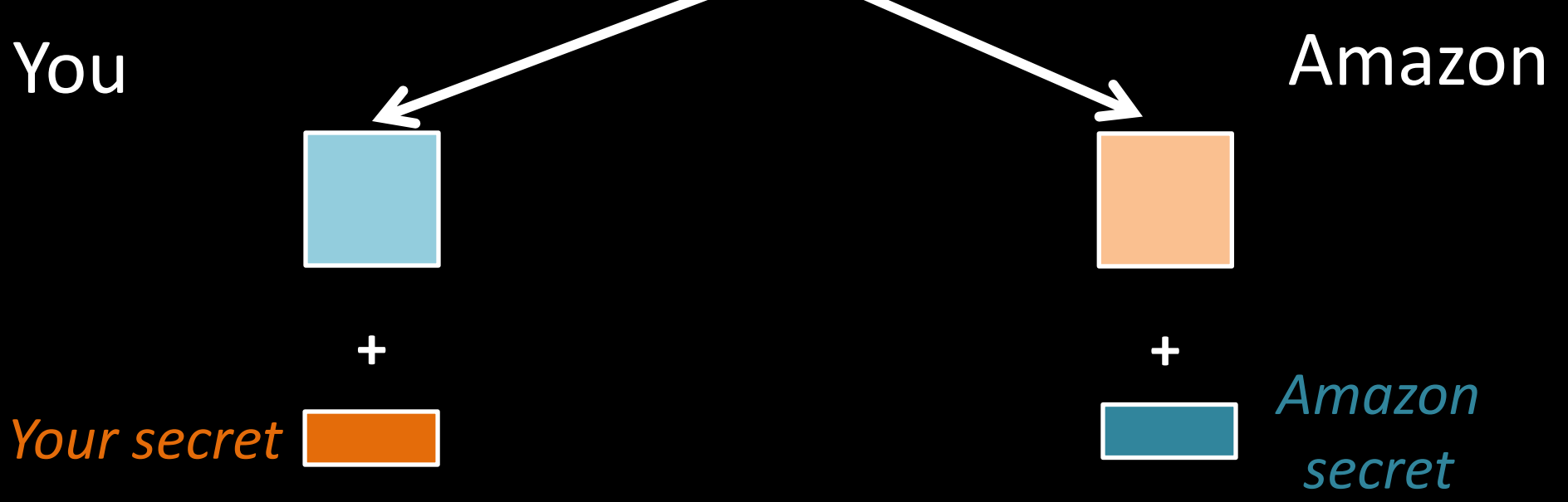
You
Amazon
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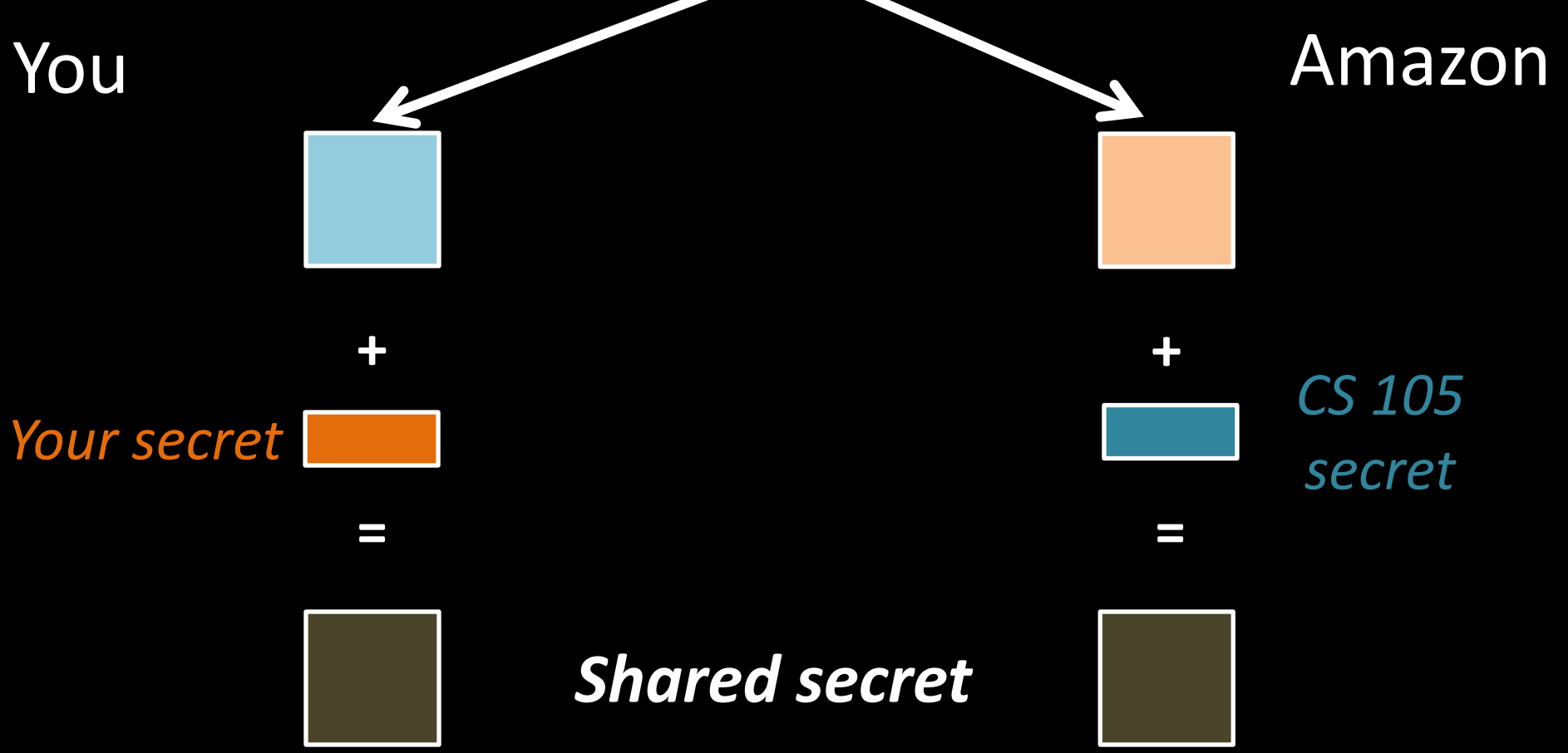
Your secret
Amazon secret


You
Amazon
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Your secret
CS 105 secret
=
=
Shared secret

You

Amazon

Your secret

CS 105 secret

Shared secret

```
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5f 71 0a d1 2e 37 d9 5e f2 38 48 77 f7 ee 3f 57
8d a5 9a e8 d2 22 46 f6 31 6a 2f c8 39 d5 cc b5
e7 12 99 4b 32 bf 74 b9 55 fd f5 08 87 6e ea 6e
66 df 0b 19 f4 d9 25 eb 66 2a 64 10 ac 1a 3e d7
4b 98 67 d6 43 90 56 42 e4 e9 c3 d1 fa 16 49 f0
31 3e ff 1f 82 f6 2c de ba 25 f3 97 9b cd 8d 7c
bd ac 8f 95 77 11 19 04 66 87 74 74 4f 7d b1 f7
f8 2a a7 fc de 97 df 54 3a d7 4a dd eb 13 3a 45
9d b7 ad e2 f5 7b b9 fb d6 45 d1 82 61 03 8b 13
0f da 1c 5a 63 80 cd 5b af eb b1 ed a0 b4 19 fa
7b a5 07 84 46 e0 33 23 08 0e 06 af f5 15 55 7f
38 a2 16 71 06 c9 f6 a6 01 72 9a 6a 2e 7b b0 d1
ed a6 e6 37 6e 0e b8 bf 81 a9 22 83 61 5e 60 84
fd 44 4e 99 0b d2 bf 82 96 d9 a4 71 9d 4b 72 5c
```

XOR

0 XOR 0 → 0

0 XOR 1 → 1

1 XOR 0 → 1

1 XOR 1 → 0

XOR

0 ← 0 XOR 0

0 XOR 1 → 1

1 XOR 0 → 1

1 XOR 1 → 0

XOR

0 ← 0 XOR 0

0 ← 1 XOR 1

1 XOR 0 → 1

1 XOR 1 → 0

XOR

0 ← 0 XOR 0

0 ← 1 XOR 1

1 ← 0 XOR 1

1 XOR 1 → 0

XOR

0 ← 0 XOR 0

0 ← 1 XOR 1

1 ← 0 XOR 1

1 ← 1 XOR 0

```
   Message: 00101001010
       Key: 10101011011
Encrypted:             1
```

```
   Message: 00101001010
       Key: 10101011011
Encrypted:           01
```

```
   Message: 00101001010
       Key: 10101011011
Encrypted:          001
```

```
   Message: 00101001010
       Key: 10101011011
Encrypted:          0001
```

```
   Message: 00101001010
       Key: 10101011011
Encrypted:        10001
```

Message: 00101001010

Key: 10101011011

Encrypted: 10000010001

Message: 00101001010

Key: 10101011011

Encrypted: 10000010001

Encrypted: 10000010001

```
   Message: 00101001010
       Key: 10101011011
Encrypted: 10000010001

Encrypted: 10000010001
       Key: 10101011011
   Message:
```

```
   Message: 00101001010
       Key: 10101011011
Encrypted: 10000010001

Encrypted: 10000010001
       Key: 10101011011
   Message:           0
```

```
   Message: 00101001010
       Key: 10101011011
Encrypted: 10000010001

Encrypted: 10000010001
       Key: 10101011011
   Message:          10
```

```
   Message: 00101001010
       Key: 10101011011
Encrypted: 10000010001

Encrypted: 10000010001
       Key: 10101011011
   Message:         010
```

```
   Message: 00101001010
       Key: 10101011011
Encrypted: 10000010001

Encrypted: 10000010001
       Key: 10101011011
   Message:        1010
```

Exclusive OR (XOR)

```
  Message: 00101001010
      Key: 10101011011
Encrypted: 10000010001

Encrypted: 10000010001
      Key: 10101011011
  Message: 00101001010
```

You

Amazon

+

+

Your secret

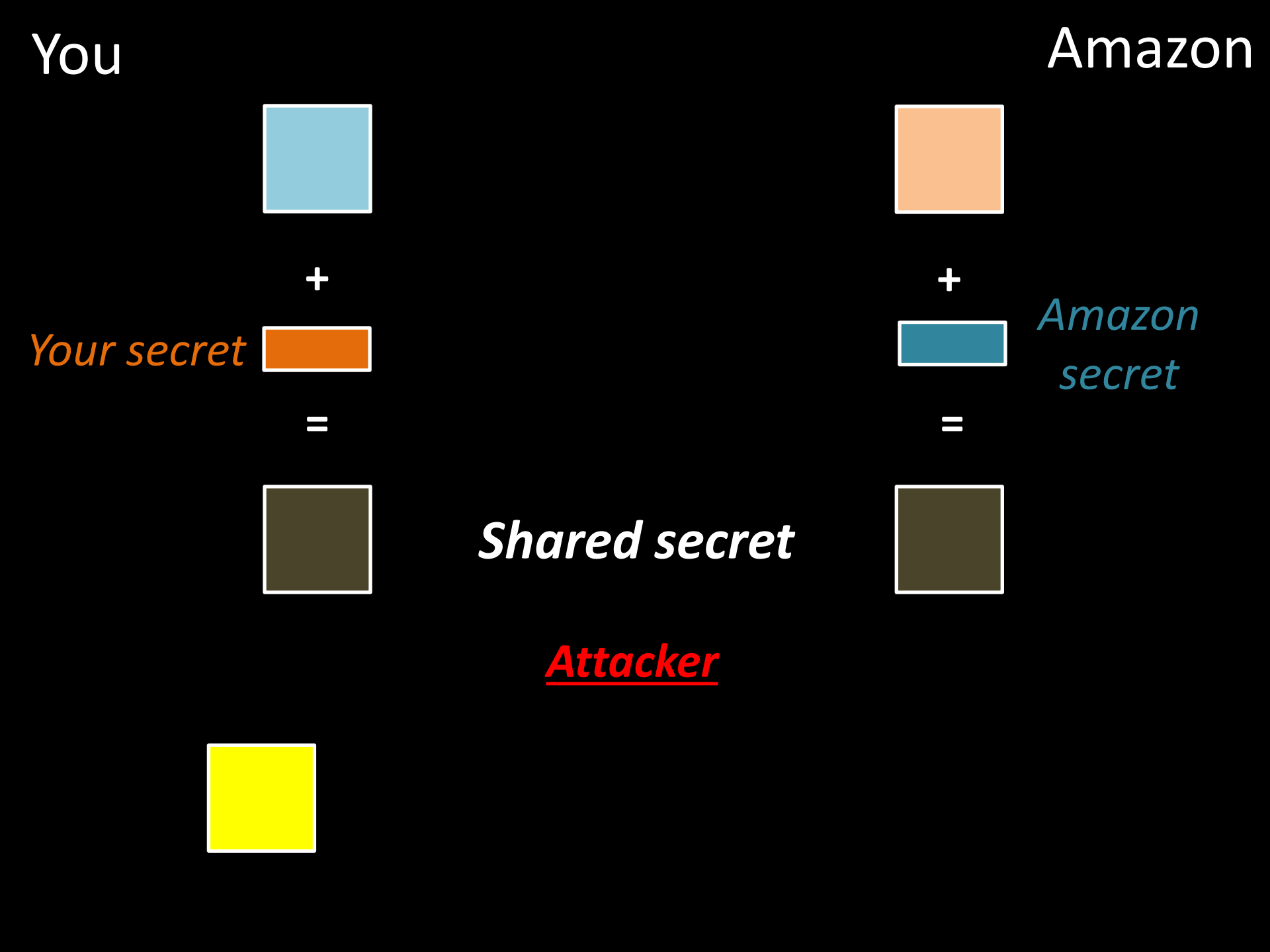
Amazon secret

=

=

Shared secret

Attacker


You
Amazon
+
+
Your secret
Amazon secret
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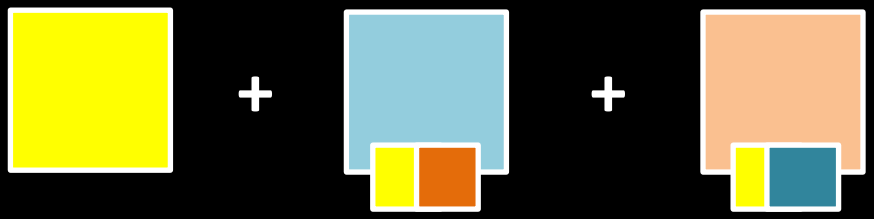
=
Shared secret
Attacker

You

Amazon

Shared secret

Attacker

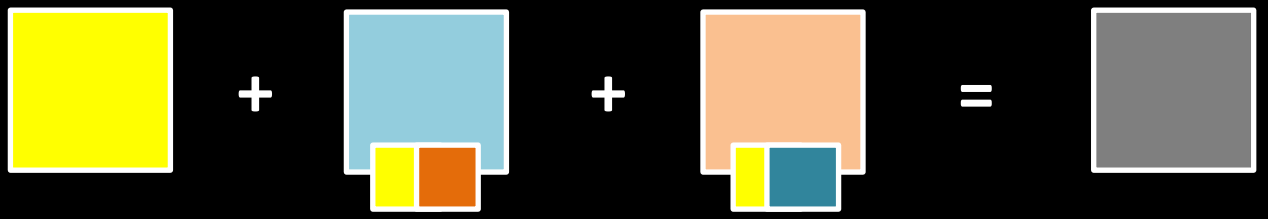


You

Amazon

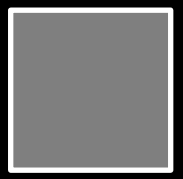
Shared secret

Attacker



You

Amazon



You

Amazon

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c8 01 98 2b 32 06 72 2c 12 f9 0d ee 1c 01 02 23
40 a5 1a d7 ec 56 02 72 13 38 69 41 05 22 64 8a
4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
f7 ef 17 50 05 be ff 2f 47 7e 99 26 19 c7 7c b7
6a b4 ac 35 c2 91 fc 2d 26 ad d3 63 76 de 3c 09
6b 8d 94 4c 9b 6a 24 1b 03 8c 3b c3 10 67 65 ca
03 b1 a2 25 3c 1c 2a 90 7e 49 e4 45 67 b2 5a 54
34 97 6e 1b 7b 5f c4 d1 b1 a5 1a d6 a5 67 6e ca
1e 6f b9 85 ff 3c 44 2b cd d6 f8 ea f9 d3 46 de
8f bd dd d9 36 fd 50 81 fb 71 72 b0 62 47 6c 91
bd 6e bd 3f be 54 2f c9 ec 51 16 5e c3 77 44 a3
40 63 3e b6 38 7f 81 a0 50 7f 81 d3 a5 7b 7c 1f
a6 09 9f a1 e9 62 44 d0 f8 83 28 9a ae be 3f 03
51 8c 67 51 f9 5b 3a 68 2c 37 9a b3 1c 49 4f 9b
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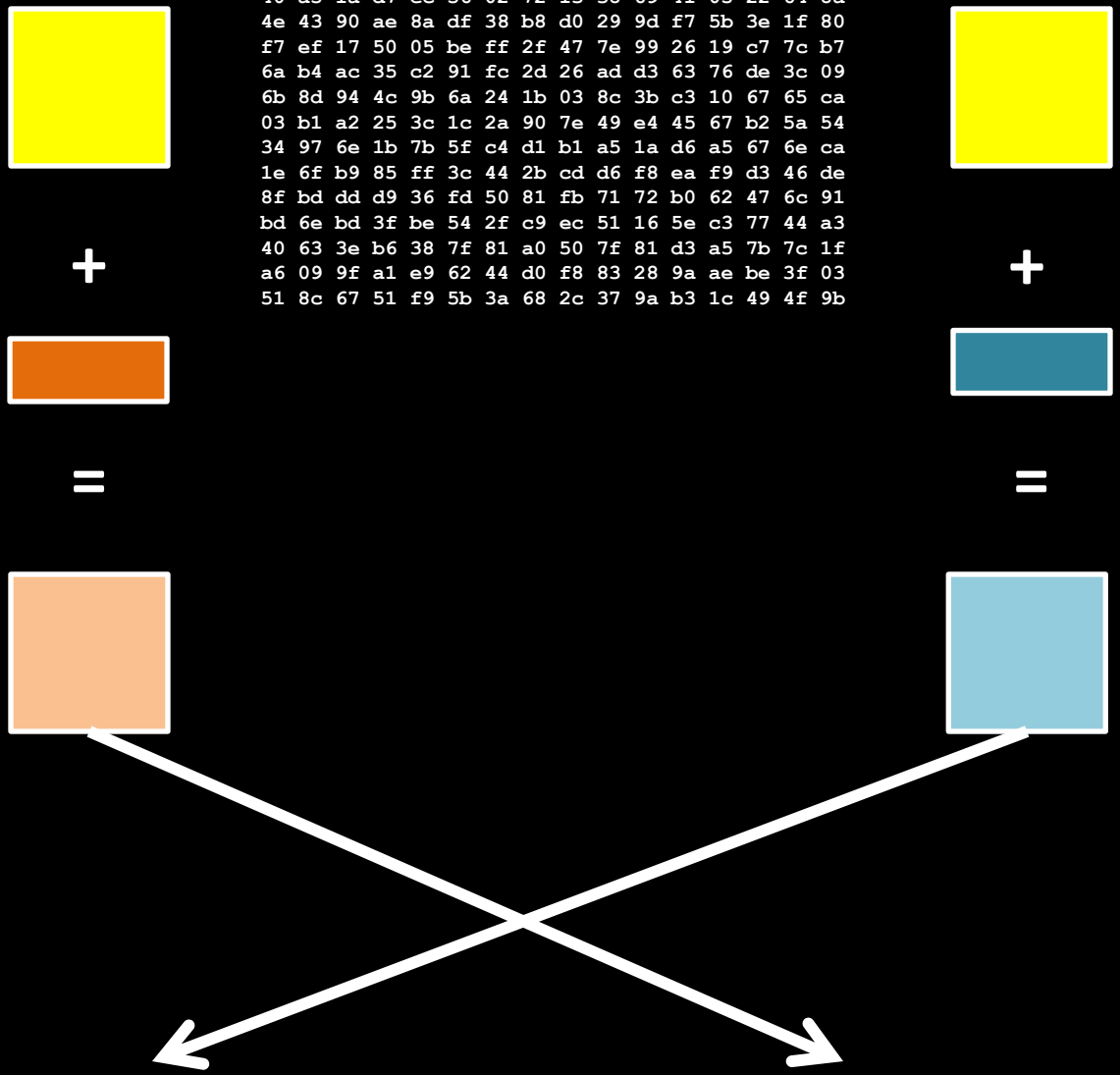

Your secret

CS 105 secret

You

Amazon

```
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c8 01 98 2b 32 06 72 2c 12 f9 0d ee 1c 01 02 23
40 a5 1a d7 ec 56 02 72 13 38 69 41 05 22 64 8a
4e 43 90 ae 8a df 38 b8 d0 29 9d f7 5b 3e 1f 80
f7 ef 17 50 05 be ff 2f 47 7e 99 26 19 c7 7c b7
6a b4 ac 35 c2 91 fc 2d 26 ad d3 63 76 de 3c 09
6b 8d 94 4c 9b 6a 24 1b 03 8c 3b c3 10 67 65 ca
03 b1 a2 25 3c 1c 2a 90 7e 49 e4 45 67 b2 5a 54
34 97 6e 1b 7b 5f c4 d1 b1 a5 1a d6 a5 67 6e ca
1e 6f b9 85 ff 3c 44 2b cd d6 f8 ea f9 d3 46 de
8f bd dd d9 36 fd 50 81 fb 71 72 b0 62 47 6c 91
bd 6e bd 3f be 54 2f c9 ec 51 16 5e c3 77 44 a3
40 63 3e b6 38 7f 81 a0 50 7f 81 d3 a5 7b 7c 1f
a6 09 9f a1 e9 62 44 d0 f8 83 28 9a ae be 3f 03
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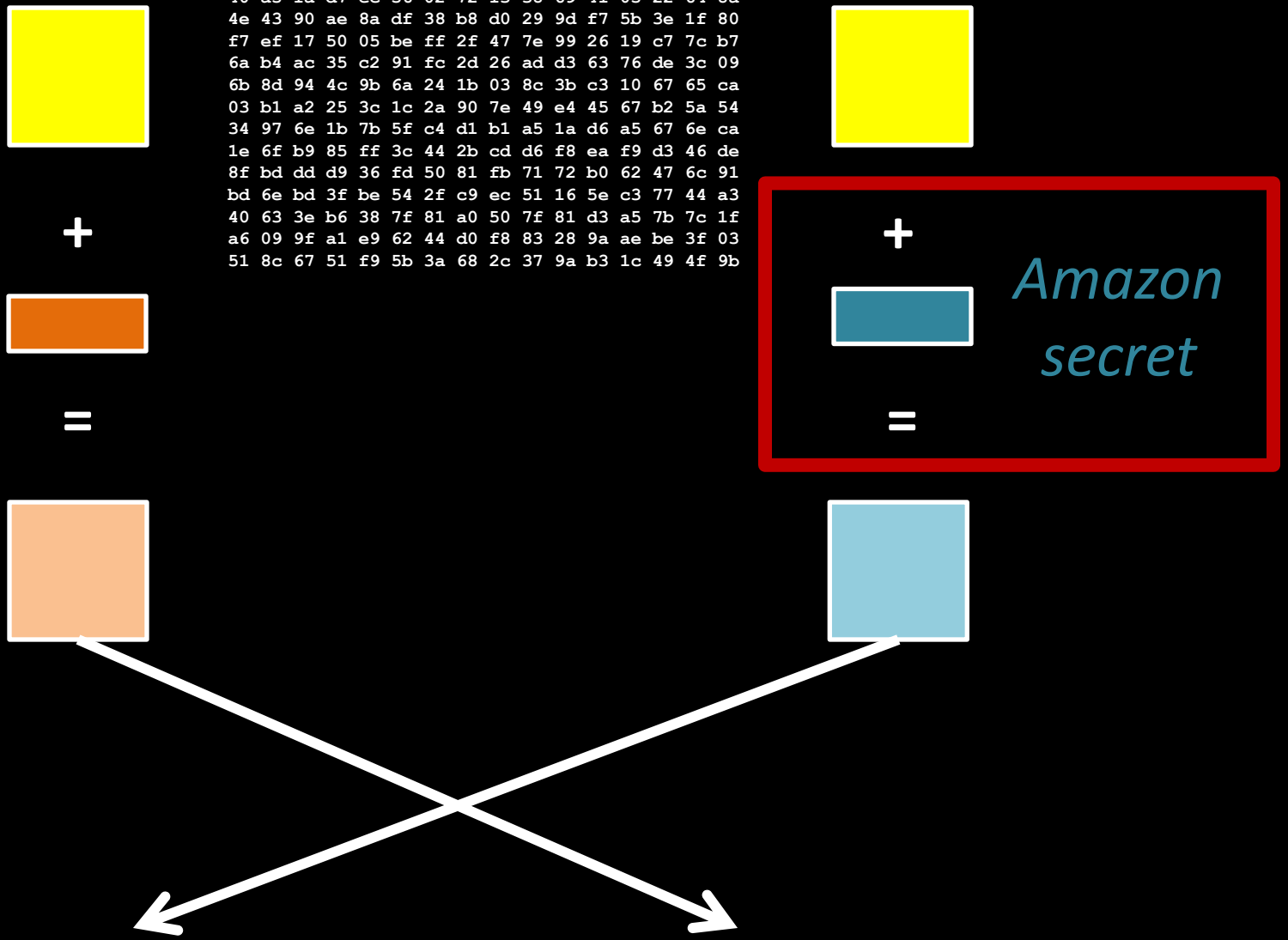
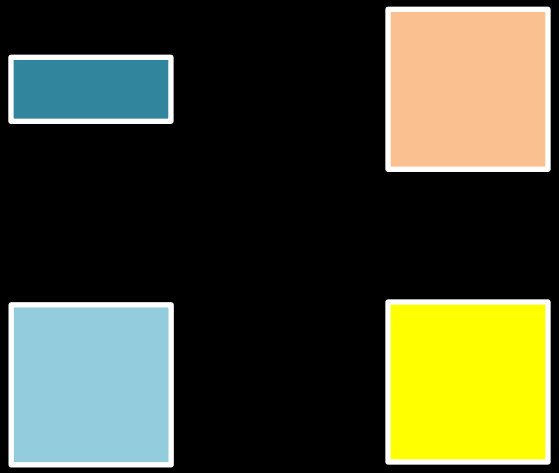


You

Amazon

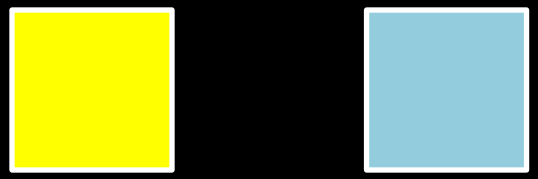
Attacker



You

Amazon

Attacker



Message: 00101001010

Key: 10101011011

Encrypted: 10000010001

Encrypted: 10000010001

Key: 10101011011

Message: 00101001010