***LAB 1 – C00236160 – Patrick Donnelly***

*Notes:*

*Number of subnets is: 2S*

*Number of Hosts per subnet is: (2H)-2*

|  |  |  |
| --- | --- | --- |
| Class | First Octet Address | Default Subnet Mask |
| A | 1 – 127n | 255 . 0 . 0. 0 |
| B | 128 - 191 | 255 . 255 . 0 . 0 |
| C | 192 -223 | 255 . 255 . 255 . 0 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Decimal | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| value | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 |
| Bit Position | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 128 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 192 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 224 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 240 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 248 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 252 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 254 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 255 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

*Problem 7:*

*Needed Subnets 2000*

*Needed Hosts 15*

*Network Address 178.100.0.0*

*Address Class:* B

*Default Subnet Mask:* 255.255.0.0

*Custom Subnet Mask:* 255.255.255.224

*Total number of subnets:* 2048

*Total number of host addresses:* 32

*Number of useable addresses:* 30

*Number of bits borrowed:* 11

*Workings:*

Number of Subnets = 211 = 2048 (11 bits)

Number of Host address = 25 = 32 (5 bits)

Number of usable hosts = (25) – 2 = 30 (Subtract two, one for broadcast, one for the network)

Custom Subnet Mask =

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Decimal | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| value | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 |
| Bit Position | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Borrowed 11 bits.

First 8 bits 128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 255

Remaining 3 bits from the 4th octet = 128 + 64 + 32 = 224

Therefore custom subnet mask is 255.255.255.224

*Problem 15:*

*Need 50 hosts*

*Network address: 172.59.0.0*

*Address Class:* B

*Default subnet mask:* 255.255.0.0

*Custom subnet mask:* 255.255.255.192

*Total number of subnets:* 1024

*Total number of Host addresses:* 64

*Number of useable addresses:* 62

*Number of bits borrowed:* 10

*Workings:*

Number of Subnets = 210 = 1024 (10 bits)

Number of Host address = 26 = 64 (6 bits)

Number of usable hosts = (26) – 2 = 62 (Subtract two, one for broadcast, one for the network)

Custom Subnet Mask =

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Decimal | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| value | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 |
| Bit Position | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Borrowed 10 bits.

First 8 bits 128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 255

Remaining 2 bits from the 4th octet = 128 + 64 = 192

Therefore custom subnet mask is 255.255.255.192

*Problem 11*

*Needed Hosts: 8,000*

*Network Address: 135.70.0.0*

*Address Class:* B

*Default subnet mask:* 255.255.0.0

*Custom subnet mask:* 255.255.224.0

*Total No. of Subnets:* 8

*Total number of host addresses:* 8192

*No of useable addresses:* 8190

*No of bits borrowed:* 3

*6th subnet range:* 135.70.160.0 -> 135.70.191.255

*Workings:*

Number of Subnets = 213 = 8192 (13 bits)

Number of Host address = 23 = 8 (3 bits)

Number of usable hosts = (213) – 2 = 8190 (Subtract two, one for broadcast, one for the network)

Custom Subnet Mask =

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Decimal | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| value | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 |
| Bit Position | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Borrowed 3 bits.

3 bits from the 3rd octet = 128 + 64 + 32 = 224

Therefore custom subnet mask is 255.255.224.0

6th Subnet Range:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Subnet | Bit Value | Network | | | Host ( Value = 0 ) | | | | | | | | | | | | | Starting Range |
| Bit Value | ----- | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | --------- |
| 1st | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.70.0.0 |
| 2nd | 32 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.70.32.0 |
| 3rd | 64 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.70.64.0 |
| 4th | 96 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.70.96.0 |
| 5th | 128 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.70.128.0 |
| 6th | 160 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.70.160.0 |
| 7th | 192 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.70.192.0 |
| 8th | 224 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.70.224.0 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Subnet | Bit Value | Network | | | Host ( Value = 286 ) | | | | | | | | | | | | | End of Range |
| Bit Value | ----- | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | --------- |
| 1st | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.70.31.255 |
| 2nd | 32 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.70.63.255 |
| 3rd | 64 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.70.95.255 |
| 4th | 96 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.70.127.255 |
| 5th | 128 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.70.159.255 |
| 6th | 160 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.70.191.255 |
| 7th | 192 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.70.223.255 |
| 8th | 224 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.70.255.255 |

To get the starting range of the 6th subnet you add the host bit value to the network bit value of that subnet.

* The host value at the start of a range is always 0 as all bits are set to 0.
* Therefor you only take into account the borrowed network bits.
* They increment by 32 each subnet based on this specific address.

To get the end of a subnet range you add the host bit value to the network bit value first.

* In this case the host value is 286 in this specific address, as all bits are set to 1.
* 13 bits = 1+2+4+8+16+32+64+128+1+2+4+8+16 = 286

Then you add 286 to the Network bit value (changes each subnet) to the start of the subnet range.

Example for the 6th subnet range.

* Network bits 1 0 1 = 128, 0, 32 = 160
* Host bits are all one = 286 as shown above
* Network Bit value + Host Bit value = 160+286 = 446

The starting range for the 6th subnet is 135.70.160.0. Add the bit value 446 to this, the 4th octet value of 0 becomes 255. The max value. And the remainder 446 – 255 = 191, replaces the 3rd octet value of 160

There for the end range is 135.70.191.255

*Problem 12*

*Needed Hosts: 45*

*Network address: 198.125.50.0*

*Address Class:* C

*Default subnet mask:* 255.255.255.0

*Custom subnet mask:* 255.255.255.192

*Number of subnets:* 4

*Number of host addresses:* 64

*Number of usable addresses:* 62

*Number of bits borrowed:* 2

*Second subnet range:* 198.125.50.64 -> 198.125.50.127

*Second subnet number:* 255.255.255.64

*Subnet broadcast address 4th subnet:* 198.125.50.255 (Last address of the subnet)

*Assignable addresses 3rd subnet range:* 198.125.50.129 -> 198.125.50.190 (+1 at start, -1 at end)

*Workings:*

*2nd subnet Range:*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Subnet | Bit Value | Network | | Host ( Value = 0 ) | | | | | | Starting Range |
| Bit Value | ----- | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | --------- |
| 1st | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 198.125.50.0 |
| 2nd | 32 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 198.125.50.64 |
| 3rd | 64 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 198.125.50.128 |
| 4th | 96 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 198.125.50.192 |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Subnet | Bit Value | Network | | Host ( Value = 63 ) | | | | | | End of Range |
| Bit Value | ----- | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | --------- |
| 1st | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 198.125.50.63 |
| 2nd | 32 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 198.125.50.127 |
| 3rd | 64 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 198.125.50.191 |
| 4th | 96 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 198.125.50.255 |

*Default subnet mask: 255.255.255.0 (Class C)*

*Custom subnet mask: 128 + 64 = 192*

*Number of subnets: 22 = 2 x 2 = 4*

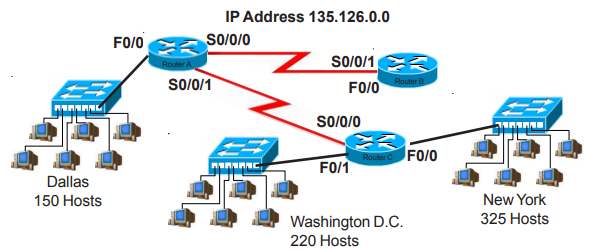
*Number of host addresses: 26 = 64*

*Number of usable addresses: 26 - 2 = 62*

*Practical Subnetting 4*

*IP Address: 135.126.0.0*

*Allow for 70% growth*



*Address Class:* B

*Custom subnet mask:* 255.255.240.0

*Minimum number of subnets needed:* 5

*Extra subnets required for growth:* 4

*Total number of subnets required:* 9

*Number of host addresses in largest subnet:* 325

*Total number of addresses needed in largest subnet:* 553

*Number of addresses needed for 70% growth in the largest subnet:* 228

*New York:* 135.126.0.0 -> 135.126.15.255

*Washington:* 135.126.16.255 -> 135.126.31.255

*Dallas:* 135.126.32.255 -> 135.126.47.255

*A -> B:*  135.126.48.255 -> 135.126.63.255

*B -> C:* 135.126.64.255 -> 135.126.79.255

*Workings:*

*Subnets Range By Department:*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Subnet | Bit Value | Network | | | Host ( Value = 0 ) | | | | | | | | | | | | | Starting Range |
| Bit Value | ----- | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | --------- |
| New York | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.126.0.0 |
| Washington | 32 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.126.16.255 |
| Dallas | 64 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.126.32.255 |
| A-B | 96 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.126.48.255 |
| B-C | 128 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135.126.64.255 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Subnet | Bit Value | Network | | | Host ( Value = 270 ) | | | | | | | | | | | | | End of Range |
| Bit Value | ----- | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | --------- |
| New York | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.126.15.255 |
| Washington | 32 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.126.31.255 |
| Dallas | 64 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.126.47.255 |
| A-B | 96 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.126.63.255 |
| B-C | 128 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 135.126.79.255 |

*Custom subnet mask: 128 + 64 + 32 +16 = 240*

*Extra subnets required for growth: 5 x 0.7 = 3.5 (4 can’t have half a subnet)*

*Total number of subnets required: 5 + 4 = 9*

*Number of host addresses in largest subnet: 325 (Seen in diagram)*

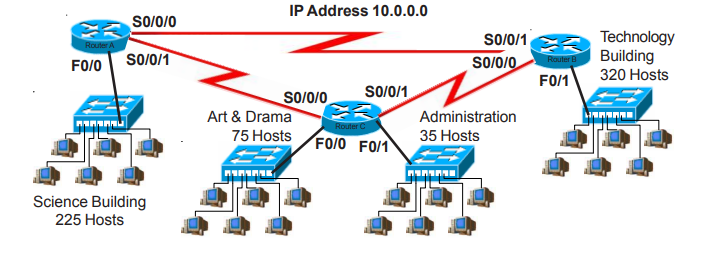
*Number of addresses needed for 70% growth in the largest subnet: 325 x .7 = 227.5 (228 can’t have half an address).*

*Total number of addresses needed in largest subnet: 325 + 228 = 553*

*Practical Subnetting 6*

*IP address: 10.0.0.0*

*Allow for 20% growth*



*Address Class:* A

*Custom subnet mask:* 255.240.0.0

*Minimum number of subnets required:* 7

*Subnets required for 20% growth:* 2

*Total number of subnets required:* 9

*Tech:* 10.0.0.0 -> 10.15.255.255

*Science:* 10.16.255.255 -> 10.31.255.255

*Art: 1* 0.32.255.255 -> 10.47.255.255

*Admin:* 10.48.255.255 -> 10.63.255.255

*A -> B:* 10.64.255.255 -> 10.79.255.255

*A -> C:* 10.80.255.255 -> 10.95.255.255

*B -> C:*  10.96.255.255 -> 10.111.255.255

*Workings:*

*Subnet Range By Department:*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Network | | | | Host ( Bit Value = 0) | | | | | | | | | | | | | | | | | | | | Start |
| Tech | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.0.0.0 |
| Science | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.16.255.255 |
| Arts | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.32.255.255 |
| Admin | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.48.255.255 |
| A-B | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.64.255.255 |
| A-C | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.80.255.255 |
| B-C | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.96.255.255 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Network | | | | Host ( Bit Value = 525 ) | | | | | | | | | | | | | | | | | | | | | End | |
| Tech | 0 | 0 | 0 | 0 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 10.15.255.255 |
| Science | 0 | 0 | 0 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 10.31.255.255 |
| Arts | 0 | 0 | 1 | 0 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 10.47.255.255 |
| Admin | 0 | 0 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 10.63.255.255 |
| A-B | 0 | 1 | 0 | 0 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 10.79.255.255 |
| A-C | 0 | 1 | 0 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 10.95.255.255 |
| B-C | 0 | 1 | 1 | 0 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 10.112.255.255 |

*Custom subnet mask: 128 + 64 + 32 + 16 = 240*

*Subnets required for 20% growth: 7 x 0.2 = 1.4 = 2 (2 can’t have .4 of a subnet)*

*Total number of subnets required: 7 + 2 = 9*