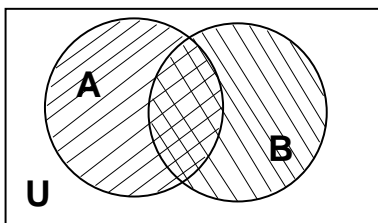## Sec 2.4 Cardinal Numbers & Surveys
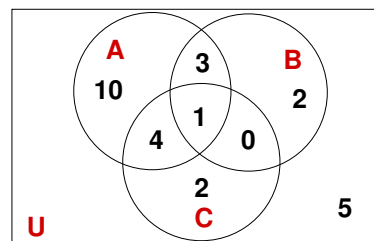
Cardinal Number Formula

For any two sets A and B:
$$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

I.e., the number of elements in the union of two sets is the sum of the number of elements in each of the sets minus the number of elements in their intersection.
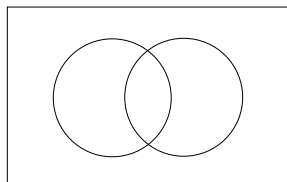

Example I

Find the cardinality of the sets:

$A \cap B \cap C$	_____	$A \cap B \cap C'$	_____
$A \cap B' \cap C$	_____	$A' \cap B \cap C$	_____
$A' \cap B' \cap C$	_____	$A \cap B' \cap C'$	_____
$A' \cap B \cap C'$	_____	$A' \cap B' \cap C'$	_____

Ex. 2 — Using Venn diagrams to display survey data

Kim is a fan of the music of Paul Simon and Art Garfunkel. In her collection of 22 CDs, she has the following:

❖ 5 on which both Simon and Garfunkel sing
❖ 8 total on which Simon sings
❖ 7 total on which Garfunkel sings
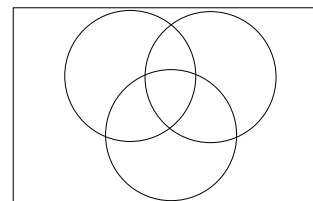❖ 12 on which neither Simon nor Garfunkel sings

1. How many of her CDs feature only Paul Simon?
2. How many of her CDs feature only Art Garfunkel?
3. How many feature at least one of these two artists?

Ex. 3 — Love, Prison, and Trucks

It was once said that Country–Western songs emphasize three basic themes: love, prison, and trucks. A survey of the local Country–Western radio station produced the following data of songs about:

❖ 12 truck drivers in love while in prison
❖ 13 prisoners in love
❖ 28 people in love
❖ 18 truck drivers in love
❖ 3 truck drivers in prison who are not in love
❖ 2 prisoners not in love and not driving trucks
❖ 8 people who are out of prison, are not in love, and do not drive trucks
❖ 16 truck drivers who are not in prison

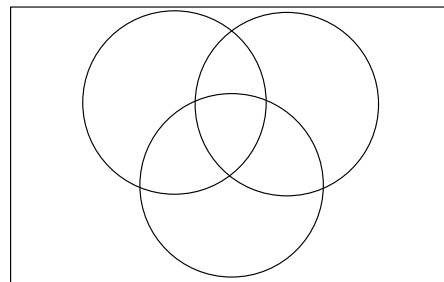| Number	Love?	Prison?	Trucks?
12			
13			
28			
18			
3			
2			
8			
16			

How many songs were…

1. Surveyed?
2. About truck drivers?
3. About prisoners?
4. About truck drivers in prison?
5. About people not in prison?
6. About people not in love?

Ex. 4 — The Peter Principle

Jim Donahue was a section chief for an electric utility company. The employees in his section cut down tall trees (T), climbed poles (P), and spliced wire (W). Donahue submitted the following report to the his manager:

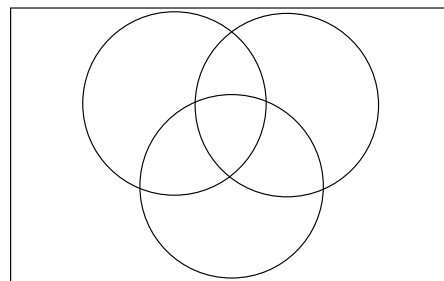|					
n(T)	=	45	n(P ∩ W)	=	20
n(P)	=	50	n(T ∩ W)	=	25
n(W)	=	57	n(T ∩ P ∩ W)	=	11
n(T ∩ P)	=	28	n(T′ ∩ P′ ∩ W′)	=	9

Donahue also stated that 100 employees were included in the report. Why did management reassign him to a new section?

Ex. 5 — Round II

Jim Donahue was reassigned to the home economics department of the electric utility company. he interviewed 140 people in a suburban shopping center to find out some of their cooking habits. He obtained the following results. There is a job opening in Siberia. Should he be reassigned yet again?

- ❖ 58 use microwave ovens
- ❖ 63 use electric ranges
- ❖ 58 use gas ranges
- ❖ 19 use microwave ovens and electric ranges
- ❖ 17 use microwave ovens and gas ranges
- ❖ 4 use both gas and electric ranges
- ❖ 1 uses all three
- ❖ 2 cook only with solar energy

Ex. 6 — Student Values

Julie Ward, who sells college textbooks, interviewed freshmen on a community college campus to determine what is important to today's students. She found that **Wealth**, **Family**, and **Expertise** topped the list. Her findings can be summarized as:

n(W)	=	160	n(E ∩ F)	=	90
n(F)	=	140	n(W ∩ F ∩ E)	=	80
n(E)	=	130	n(E′)	=	95
n(W ∩ F)	=	95	n[(W ∪ F ∪ E)′]	=	10

How many students were interviewed?