

# Software Requirement Engineering (SE-211)

Lecture 28: Estimation

# Estimation

- Experience and Beware of the Sales Guy



# Cost Estimation

- Project scope must be explicitly defined
- Task, functional, or component decomposition is necessary
- Historical measures (metrics) are very helpful
- To assure fit, use two or more estimation techniques
- Uncertainty is inherent in most estimation endeavors – plan on it!

*Planning Poker is a  
consensus-based estimation  
technique used by Agile  
teams globally.*

# Step-01: Organization of the game

- Full team will involve in Planning Poker game.
- Will require 2–4 hours
- Also require a large table where all members will sit.
- Each team member will have a set of cards
- In each card set there will have 10 cards with numbering 0, 1, 2, 3, 5, 8, 13, 21, 40 and 100 i.e. 1st card's no will 0, 2nd card's no will 1, 3rd card's no will 2, 4th card's no will 3, 5th will 4, 6th will 8, 7th will 13, 8th will 21, 9th will 40 and 10th will 100

# **Step-02: Introducing Story by Product Owner**

- The Product Owner introduces the user story by talking about:
- The motivation for doing the user story.
- The intended outcome and benefits.
- The scope of the user story (including what is not in scope with this user story).
- Other relevant considerations.

# Step-03: Discussing about the Story

- What should happen in a given scenario?
- What should happen in some negative case or edge case (i.e. plausible but not common scenario)?
- Do we need to build this for one type, several user types or all users?
- Do we need to track any new performance metrics in order to understand if this user story is working as expected?

# Step-04: Playing Cards

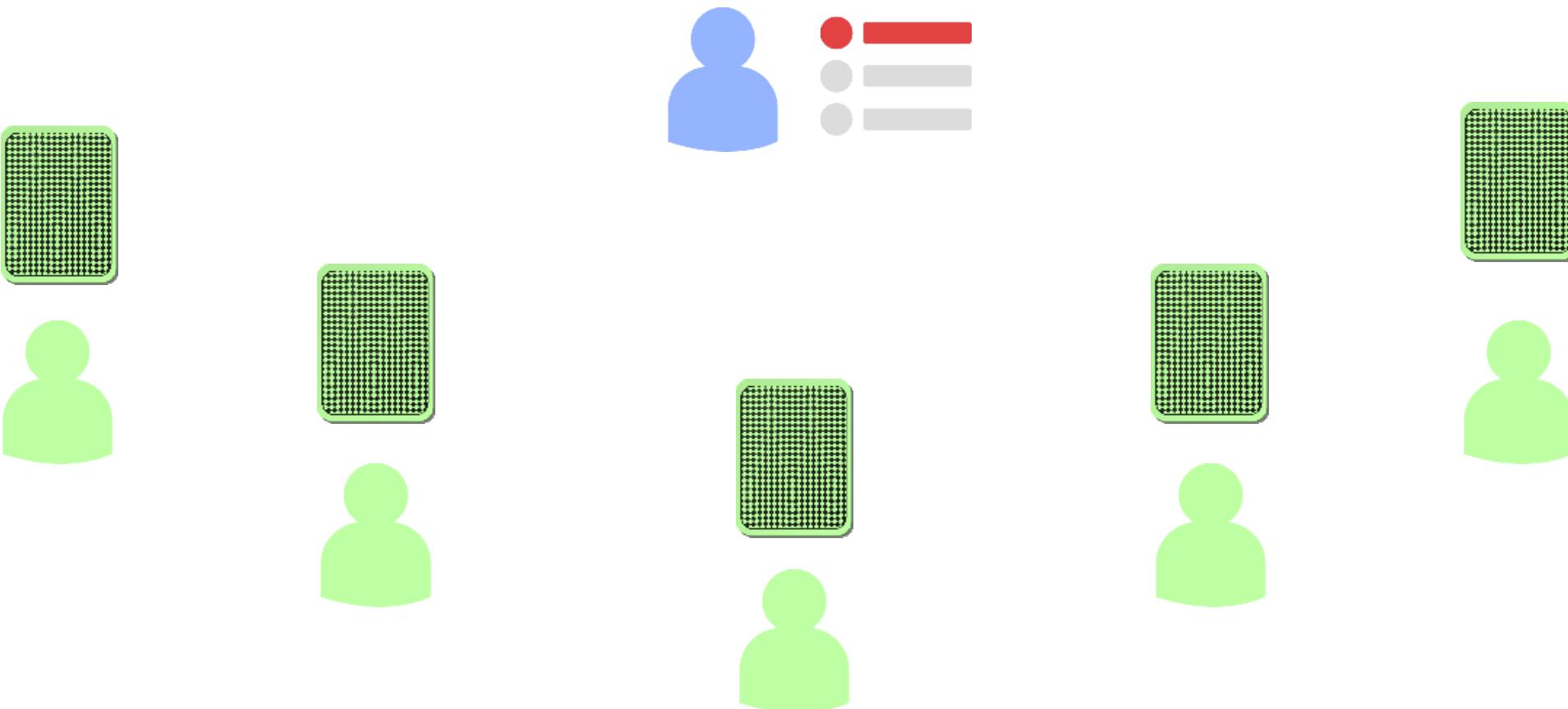
- After discussion team members will ask to point for that story i.e. Product owner will ask them ***Now Select your card for assign Story Point to this story***
- Each team member will select their card and put it on the table with face down, so that others can't see his/her point.

# Step-05: Achieving Consensus

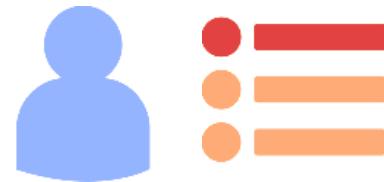
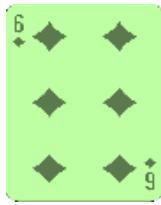
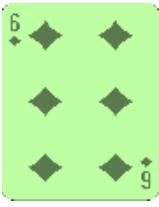
- Most of the time one thing will identify which is **a huge mismatch between given numbers.**
- In that case members with highest and lowest numbers will ask why their chose estimates
- They will give some justification and discuss with the team regarding this issue. This will also help the team if they have any misunderstanding or vogue idea about the story and adjusting their estimation
- After justification the process i.e. Step-04 will continue again
- This process will continue until all members agrees to a common estimate
- Once all team members agrees to a common estimate then Product owner will record that point and go for next story and will continue from step-02 to step-05
- If after 5–6 rounds of playing the game estimation fail meet all members agreement then put it aside for revisit later



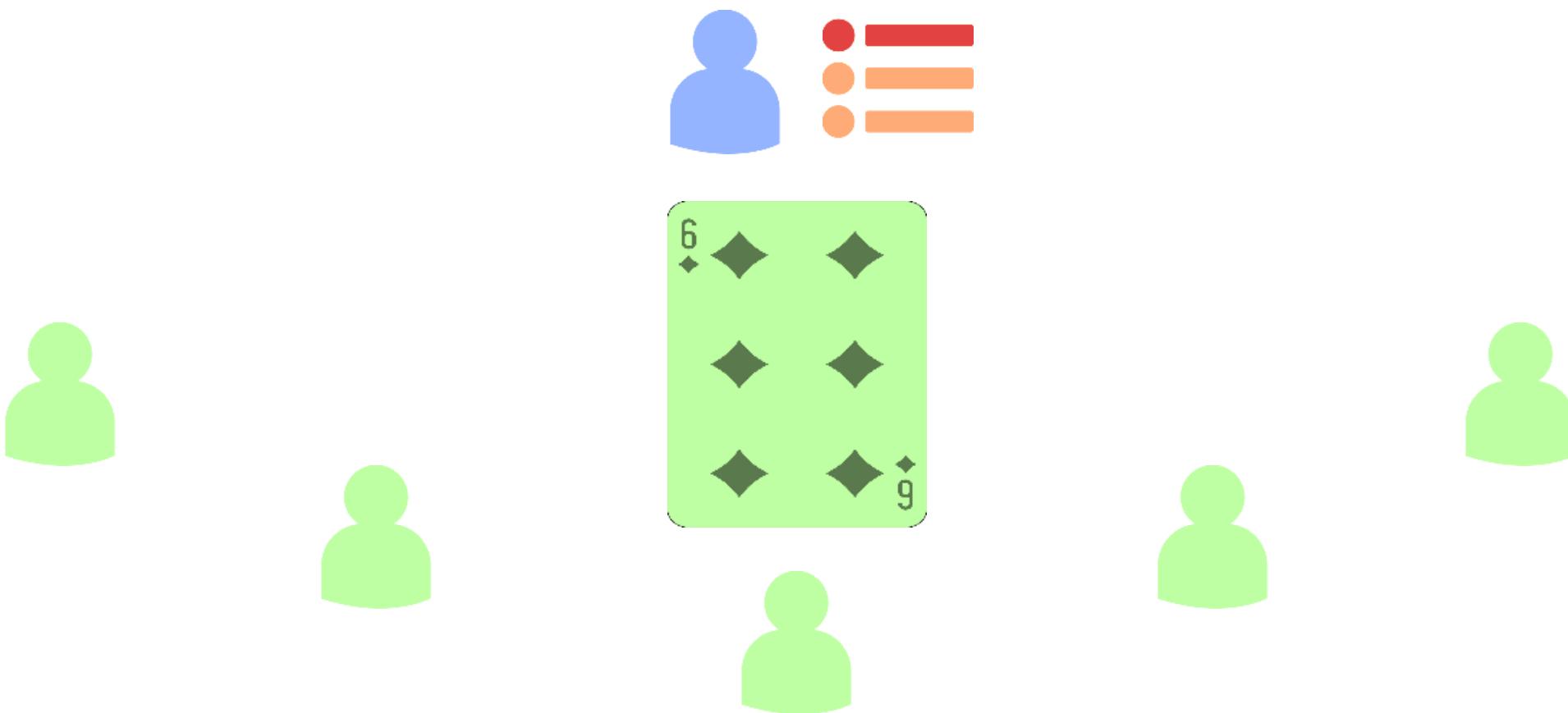
# HOW IT WORKS



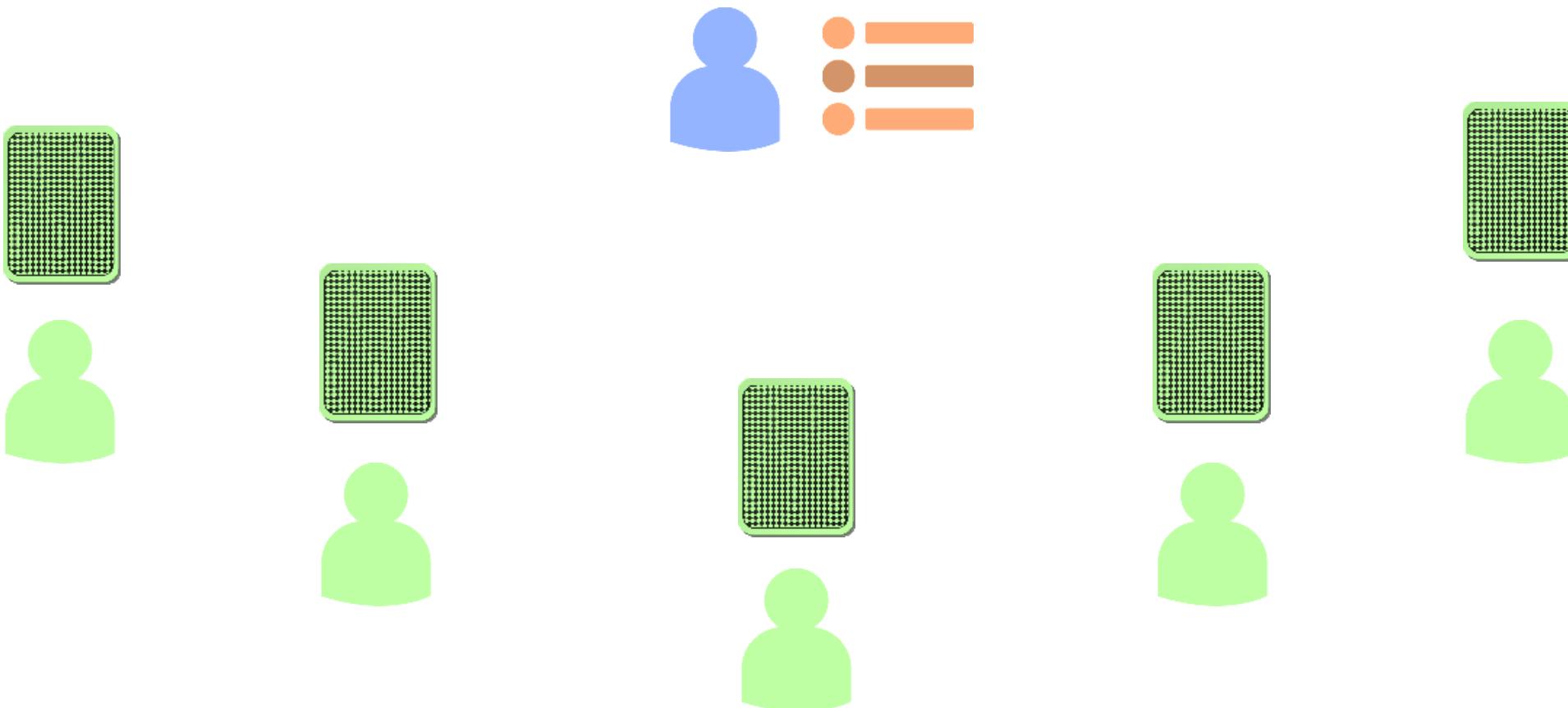
# HOW IT WORKS



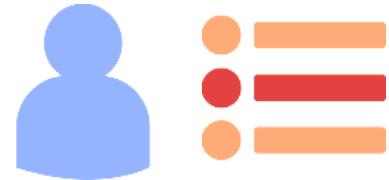
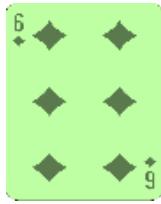
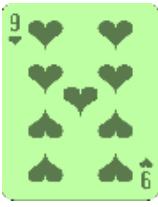
# HOW IT WORKS



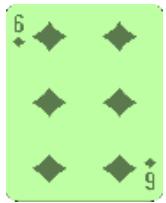
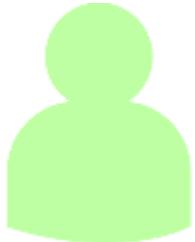
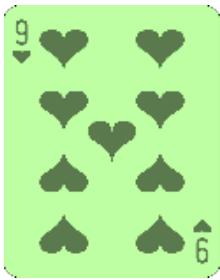
# HOW IT WORKS



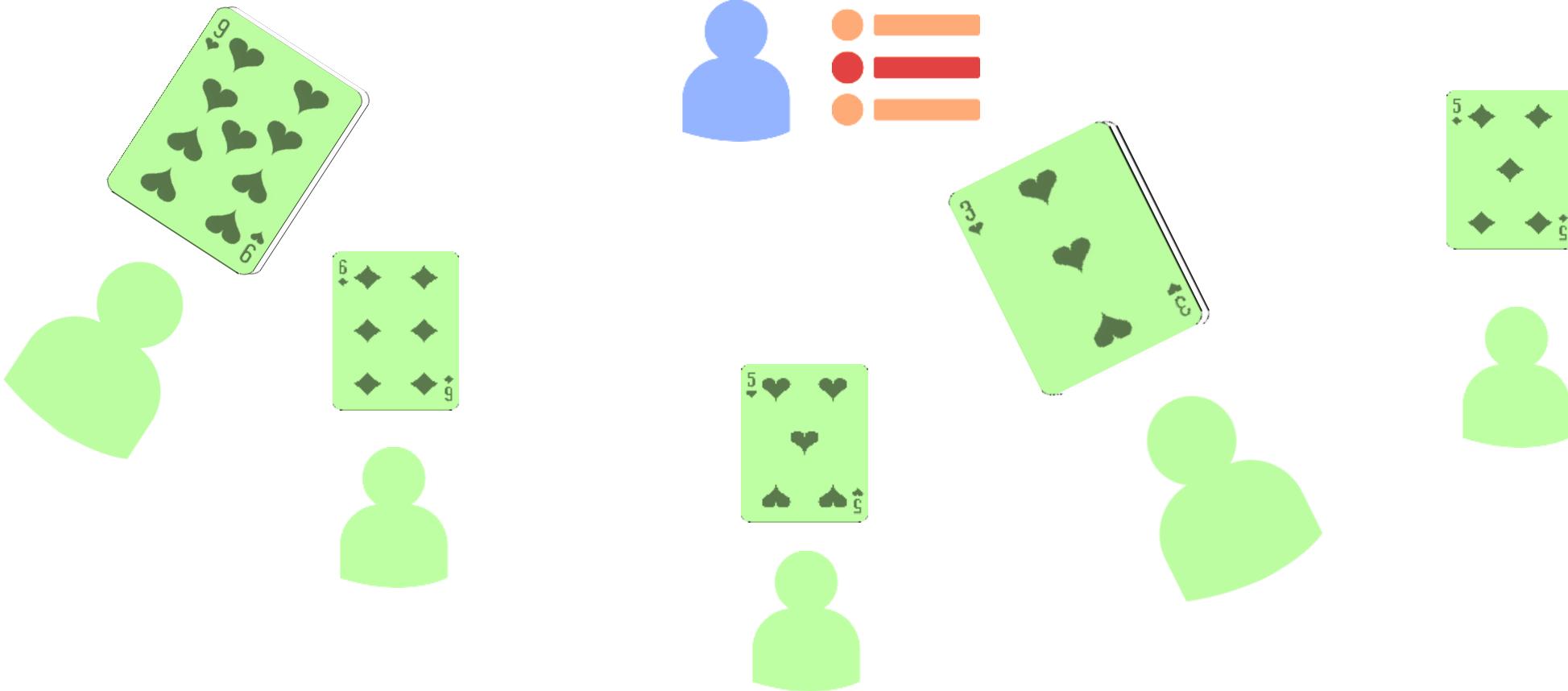
# HOW IT WORKS



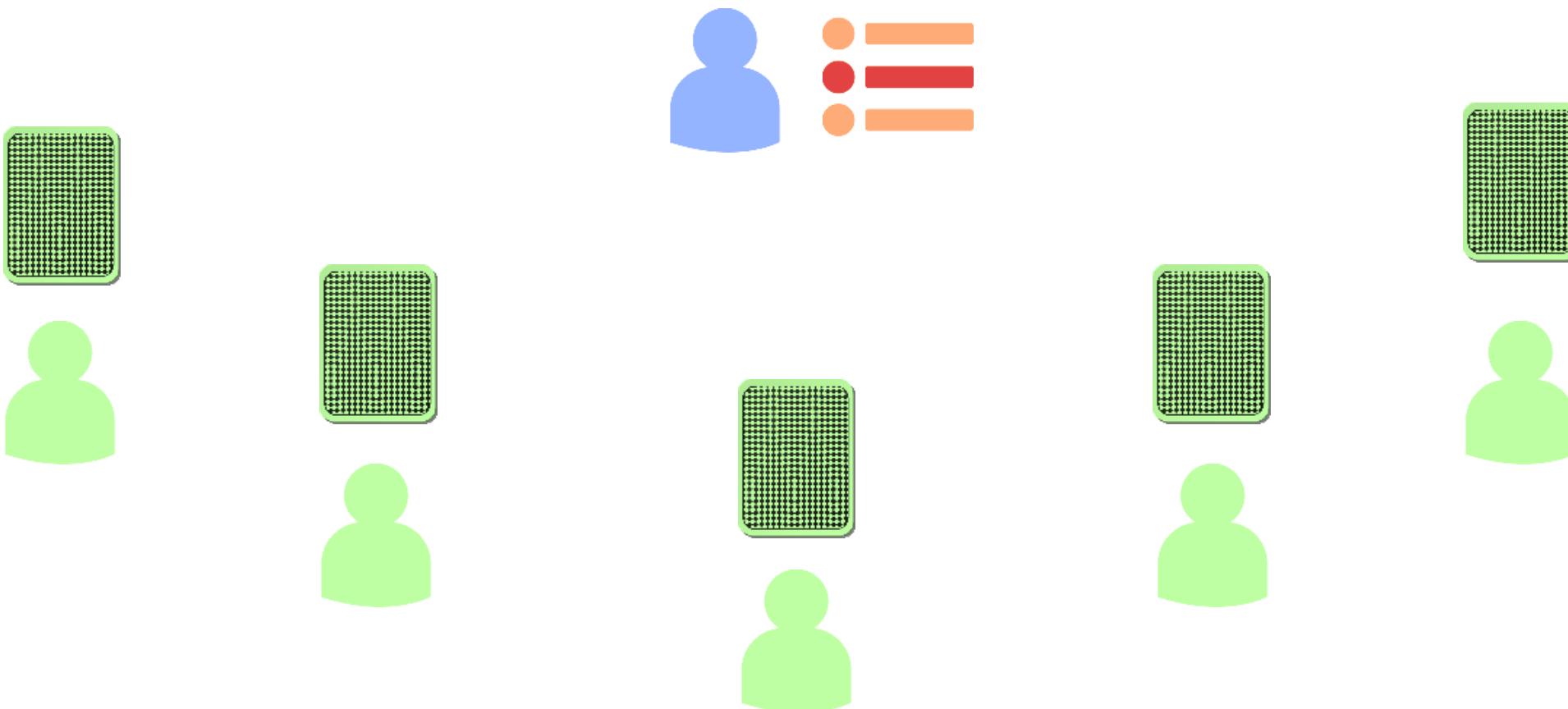
# HOW IT WORKS



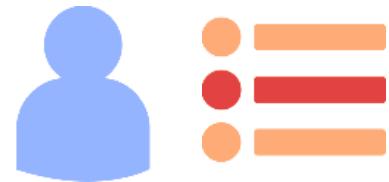
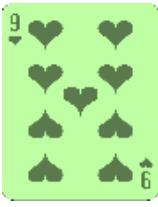
# HOW IT WORKS



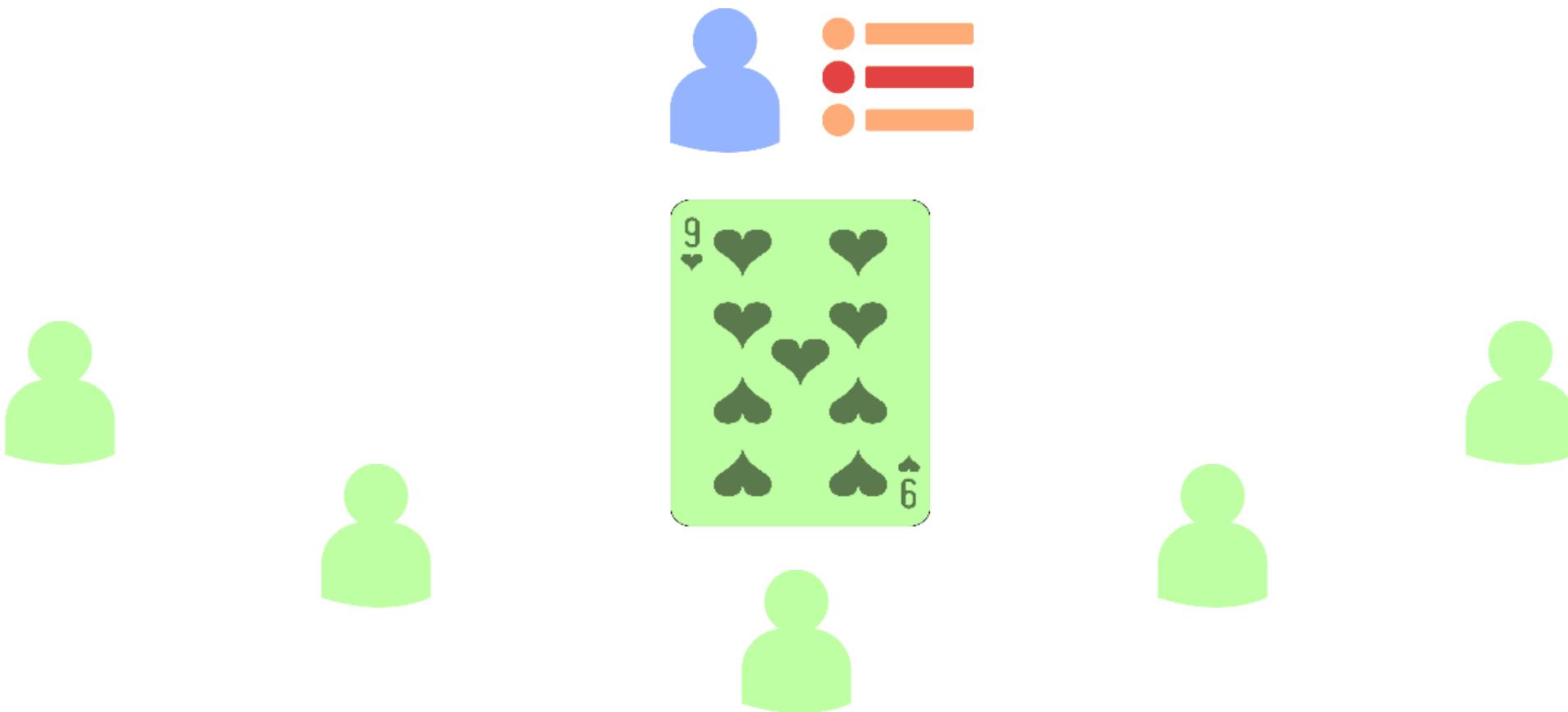
# HOW IT WORKS



# HOW IT WORKS



# HOW IT WORKS





## DISAGREEMENTS

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- HOW TO GET THE FINAL ESTIMATE
  - Keep voting until everyone votes the same number
  - Keep voting until estimates are “close enough” and average them
  - Average the votes even if they’re not very close
  - When averaging, keep exact average or round up

## DISAGREEMENTS

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- HOW TO GET THE FINAL ESTIMATE
- NUMBER SEQUENCING
  - *Playing Cards:*
    - Ace, 2, 3, 4, 5, 6... King
  - *Modified Fibonacci:*
    - 0,  $\frac{1}{2}$ , 1, 3, 5, 8, 13, 20, 40, 100
  - *Sequential:*
    - 0,  $\frac{1}{2}$ , 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15...
  - *T-Shirt Sizes:*
    - xxS, xs, s, m, l, xl, xxl
  - *With Icons:*
    - Infinity means it can't be done, coffee cup means I need a break
  - And what do the numbers mean? Story points, ideal days, etc.



## DISAGREEMENTS

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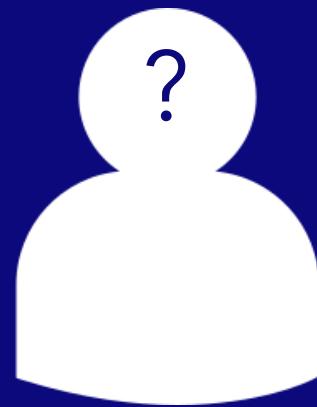
- HOW TO GET THE FINAL ESTIMATE
- NUMBER SEQUENCING
- TO TIME OR NOT TO TIME
  - Original purpose was to keep estimation meetings moving (Agile Alliance)
  - Use a timer to limit each round?
  - Use a timer to limit vote justifications?
  - How long to set in both cases?



## DISAGREEMENTS

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- HOW TO GET THE FINAL ESTIMATE
- NUMBER SEQUENCING
- TO TIME OR NOT TO TIME



# BENEFITS

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- Promotes accuracy, prevents bias
- Keeps things organized & moving
- Can assist in task assignment
- Allows for multiple timelines based on cuts





196

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#### RAW MATH

- 6 Devs
- 5 days/week
- 30 points/week
- $196/30 = 6.4$  weeks!

# 2016

## January

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

## February

S	M	T	W	Th	F	S
					1	2
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29				27	28
					29	30
					31	

## March

S	M	T	W	Th	F	S
					1	2
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		
					24	25
					26	27
					28	29
					30	31

## April

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

## May

S	M	T	W	Th	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31			26	27

## June

S	M	T	W	Th	F	S
					1	2
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		24
					25	26
					27	28
					29	30
					31	

## July

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
28	29	30	31			

## August

S	M	T	W	Th	F	S
					1	2
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

## September

S	M	T	W	Th	F	S
			1	2	3	
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	
			30	31		

## October

S	M	T	W	Th	F	S
			1			
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
27	28	29	30			
					25	26
					27	28
					29	30
					31	

## November

S	M	T	W	Th	F	S
			1	2	3	4
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			
					25	26
					27	28
					29	30
					31	

## December

S	M	T	W	Th	F	S
			1	2	3	
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31



196

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RAW MATH = 6.4 weeks

VELOCITY

- 20 points/week
- $196/20 = 9.8$  weeks!

# 2016

## January

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

## February

S	M	T	W	Th	F	S
		1	2	3	4	5
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29					

## March

S	M	T	W	Th	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		
24	25	26	27	28	29	30

## April

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

## May

S	M	T	W	Th	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

## June

S	M	T	W	Th	F	S
		1	2	3	4	5
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

## July

S	M	T	W	Th	F	S
		1	2			
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
28	29	30	31			

## August

S	M	T	W	Th	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27

## September

S	M	T	W	Th	F	S
		1	2	3		
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	
30	31					

## October

S	M	T	W	Th	F	S
	1					
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
27	28	29	30			
30	31					

## November

S	M	T	W	Th	F	S
	1	2	3	4	5	
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			
25	26	27	28	29	30	31

## December

S	M	T	W	Th	F	S
	1	2	3			
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31



196

RAW MATH = 6.4 weeks  
VELOCITY = 9.8 weeks

#### MAINTENANCE

- 3 points/week
- Velocity = 17/week
- $196/17 = 11.5$  weeks!

# 2016

January							February							March							April							
S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	
					1	2		1	2	3	4	5	6		1	2	3	4	5						1	2		
3	4	5	6	7	8	9	7	8	9	10	11	12	13	6	7	8	9	10	11	12	3	4	5	6	7	8	9	
10	11	12	13	14	15	16	14	15	16	17	18	19	20	13	14	15	16	17	18	19	10	11	12	13	14	15	16	
17	18	19	20	21	22	23	21	22	23	24	25	26	27	20	21	22	23	24	25	26	17	18	19	20	21	22	23	
24	25	26	27	28	29	30	28	29						27	28	29	30	31			24	25	26	27	28	29	30	
31																												
May							June							July							August							
S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	
1	2	3	4	5	6	7		1	2	3	4				1	2					1	2						
8	9	10	11	12	13	14	5	6	7	8	9	10	11	3	4	5	6	7	8	9	7	8	9	10	11	12	13	
15	16	17	18	19	20	21	12	13	14	15	16	17	18	10	11	12	13	14	15	16	14	15	16	17	18	19	20	
22	23	24	25	26	27	28	19	20	21	22	23	24	25	17	18	19	20	21	22	23	21	22	23	24	25	26	27	
29	30	31					26	27	28	29	30			24	25	26	27	28	29	30	28	29	30	31				
														31														
September							October							November							December							
S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	
					1	2	3						1		1	2	3	4	5					1	2	3		
4	5	6	7	8	9	10	2	3	4	5	6	7	8	6	7	8	9	10	11	12	4	5	6	7	8	9	10	
11	12	13	14	15	16	17	9	10	11	12	13	14	15	13	14	15	16	17	18	19	11	12	13	14	15	16	17	
18	19	20	21	22	23	24	16	17	18	19	20	21	22	20	21	22	23	24	25	26	18	19	20	21	22	23	24	
25	26	27	28	29	30		23	24	25	26	27	28	29	27	28	29	30				25	26	27	28	29	30	31	
							30	31																				



196

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RAW MATH = 6.4 weeks

VELOCITY = 9.8 weeks

MAINTENANCE = 11.5 weeks

#### UNKNOWNs

- 35% increase!
- $196 * .35 = 67.55$
- $196 + 67.55 = 263.55$
- $263.55/17 = 15.5$  weeks!

# 2016

## January

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
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31						

## February

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		1	2	3	4	5
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29					

## March

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6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		
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## April

S	M	T	W	Th	F	S
						1
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

## May

S	M	T	W	Th	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
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## June

S	M	T	W	Th	F	S
		1	2	3	4	5
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

## July

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3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
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## August

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	1	2	3	4	5	6
7	8	9	10	11	12	13
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## October

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		1				
2	3	4	5	6	7	8
9	10	11	12	13	14	15
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23	24	25	26	27	28	29
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## November

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13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			
25	26	27	28	29	30	31

## December

S	M	T	W	Th	F	S
	1	2	3			
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31



196

RAW MATH = 6.4 weeks  
VELOCITY = 9.8 weeks  
MAINTENANCE = 11.5 weeks  
UNKNOWNS = 15.5 weeks

# DAYS OFF

- Thanksgiving = 1 week
  - Vacations/Sick = 1 week
  - Total = 17.5 weeks

# 2016

## January

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

## February

S	M	T	W	Th	F	S
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28	29					

## March

S	M	T	W	Th	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		
24	25	26	27	28	29	30

## April

S	M	T	W	Th	F	S
						1
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

## May

S	M	T	W	Th	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

## June

S	M	T	W	Th	F	S
		1	2	3	4	5
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

## July

S	M	T	W	Th	F	S
		1	2			
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
28	29	30	31			

## August

S	M	T	W	Th	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

## September

S	M	T	W	Th	F	S
		1	2	3		
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	
30	31					

## October

S	M	T	W	Th	F	S
		1				
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
27	28					

## November

S	M	T	W	Th	F	S
	1	2	3	4	5	
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			
25	26	27	28	29	30	31

## December

S	M	T	W	Th	F	S
	1	2	3			
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31



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RAW MATH = 6.4 weeks

VELOCITY = 9.8 weeks

MAINTENANCE = 11.5 weeks

UNKNOWNNS = 15.5 weeks

DAY OFF = 17.5 weeks

#### QUALITY ASSURANCE

- Regression Testing & Cleanup = 1 week
- Total = 18.5 weeks!

# 2016

## January

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

## February

S	M	T	W	Th	F	S
					1	2
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29				27	28
					29	30
					31	

## March

S	M	T	W	Th	F	S
					1	2
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		
					24	25
					26	27
					28	29
					30	31

## April

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

## May

S	M	T	W	Th	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31			26	27

## June

S	M	T	W	Th	F	S
					1	2
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		24
					25	26
					27	28
					29	30
					31	

## July

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
28	29	30			28	29
					30	31

## August

S	M	T	W	Th	F	S
					1	2
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

## September

S	M	T	W	Th	F	S
			1	2	3	
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	
30	31					

## October

S	M	T	W	Th	F	S
			1			
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
27	28			29	30	
30	31					

## November

S	M	T	W	Th	F	S
			1	2	3	4
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			
					25	26
					27	28
					29	30
					31	

## December

S	M	T	W	Th	F	S
			1	2	3	
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31



## PLAN FOR

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1. HISTORICAL VELOCITY
2. MAINTENANCE
3. UNKNOWNs
4. DAYS OFF
5. QUALITY ASSURANCE



# 2016

## January

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

## February

S	M	T	W	Th	F	S
		1	2	3	4	5
7	8	9	10	11	12	13
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28	29					

## March

S	M	T	W	Th	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		
24	25	26	27	28	29	30

## April

S	M	T	W	Th	F	S
						1
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

## May

S	M	T	W	Th	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

## June

S	M	T	W	Th	F	S
		1	2	3	4	5
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

## July

S	M	T	W	Th	F	S
		1	2			
3	4	5	6	7	8	9
10	11	12	13	14	15	16
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24	25	26	27	28	29	30
28	29	30	31			

## August

S	M	T	W	Th	F	S
	1	2	3	4	5	6
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## September

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18	19	20	21	22	23	24
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30	31					

## October

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		1				
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## November

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27	28	29	30			
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## December

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11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31





# ESTIMATION

GOOD ESTIMATORS DO NOT EXAGGERATE.  
IF IT'S HUGE, THEY SAY SO. YOU SHOULD BELIEVE THEM.

# COCOMO II

# COCOMO II

- COCOMO is defined in terms of three different models:
  - the **Basic model**,
  - the **Intermediate model**, and
  - the **Detailed model**.
- The more complex models account for more factors that influence software projects, and make more accurate estimates.

# The Development Mode

- the most important factors contributing to a project's duration and cost is the Development Mode
  - **Organic Mode:** The project is developed in a familiar, stable environment, and the product is similar to previously developed products. The product is relatively small, and requires little innovation.
  - **Semidetached Mode:** The project's characteristics are intermediate between Organic and Embedded.

# The Development Mode

- the most important factors contributing to a project's duration and cost is the Development Mode:
  - **Embedded Mode:** The project is characterized by tight, inflexible constraints and interface requirements. An embedded mode project will require a great deal of innovation.

# Modes

<b>Feature</b>	<b>Organic</b>	<b>Semidetached</b>	<b>Embedded</b>
Organizational understanding of product and objectives	Thorough	Considerable	General
Experience in working with related software systems	Extensive	Considerable	Moderate
Need for software conformance with pre-established requirements	Basic	Considerable	Full
Need for software conformance with external interface specifications	Basic	Considerable	Full

# Modes

<b>Feature</b>	<b>Organic</b>	<b>Semidetached</b>	<b>Embedded</b>
Concurrent development of associated new hardware and operational procedures	Some	Moderate	Extensive
Need for innovative data processing architectures, algorithms	Minimal	Some	Considerable
Premium on early completion	Low	Medium	High
Product size range	<50 KDSI	<300KDSI	All

# Cost Estimation Process

- Cost = Size of the Project \* Productivity

# Basic COCOMO Model

- Computes software development effort (and cost) as function of program size expressed in estimated lines of code
- Model

Category	Ab	Bb	Cb	Db
Organic	2.4	1.05	2.5	0.38
Semi-detached	3.0	1.12	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

# Basic COCOMO Equations

$$E = abkLOC^{b_1}$$

$$D = c_b E^{d_b}$$

- Where
  - E is effort in person-months
  - D is development time in months
  - KLOC is estimated number of line of codes

- $P = E/D$
- P total number of persons required to accomplish the project

# Example

- Consider a software project using semi-detached mode with 30000 lines of code. We will obtain estimation for this project as follows:

$$E = abkLOC^b$$

- $E=3.0(30)^{1.12}$   
=135 person-month

- Duration estimation

$$D = c_b E^{db}$$

$$\begin{aligned} D &= 2.5(135)^{0.35} \\ &= 14 \text{ months} \end{aligned}$$

- Person estimation

$$P = E/D$$

$$= 135/14$$

= 10 persons approximately