



**Mansoura University**  
**Faculty of Computers and Information**  
**Department of Computer Science**  
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**Software Cost Estimation**

**Grade : 4 ( SWE)**

**Week : 3**

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# Software Cost Estimation



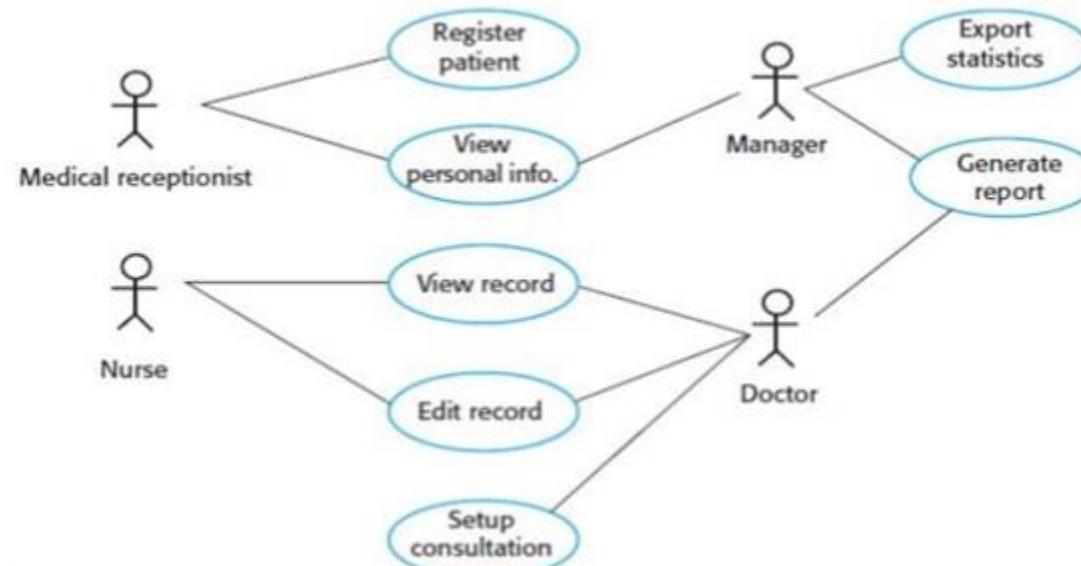
# Agenda

- ❑ Use Case
- ❑ Use Case Points (UCPs)
- ❑ Advantages of Use-Case Points
- ❑ Disadvantages of Use-Case Points
- ❑ Examples



# Use Case Diagram

- A **use case** describes a **function** that a system performs to achieve the user's goal.
- A **use case** is a methodology used in system analysis to identify, clarify and organize system requirements. The use case is made up of a set of possible sequences of interactions between **systems and users** in a particular environment and related to a particular goal.



# Use Case Points (UCPs)

**The Use-Case Points counting process has the following steps :**

- ❖ Calculate unadjusted UCPs
- ❖ Adjust for technical complexity
- ❖ Adjust for environmental complexity
- ❖ Calculate adjusted UCPs

# Unadjusted Use Case Points (UCPs)

**Calculate Unadjusted Use-Case Points as follows:**

- ❖ Determine Unadjusted Use-Case Weight
- ❖ Determine Unadjusted Actor Weight
- ❖ Calculate Unadjusted Use-Case Points

**Step 1 : Calculate Unadjusted Use-Case Weight**

Unadjusted Use-Case Weight (UUCW) = **5** \* (Number of Simple Use Case (NSUC))  
+ **10** \* (Number of Average Use Case (NAUC))  
+ **15** \* (Number of Complex Use Case (NCUC))

# Unadjusted Use Case Points (UCPs)

## Step 1 : Calculate Unadjusted Use-Case Weight

Use-Case Complexity	Number of Transactions	Use-Case Weight
Simple	$\leq 3$	5
Average	4 to 7	10
Complex	$> 7$	15

Use-Case Complexity	Use-Case Weight	Number of Use-Cases	Product
Simple	5	NSUC	$5 \times NSUC$
Average	10	NAUC	$10 \times NAUC$
Complex	15	NCUC	$15 \times NCUC$
<b>Unadjusted Use-Case Weight (UUCW)</b>			$5 \times NSUC + 10 \times NAUC + 15 \times NCUC$

# Unadjusted Use Case Points (UCPs)

## Step 2 : Calculate Unadjusted Actor Weight

**Unadjusted Actor Weight (UAW) = 1 \* (Number of Simple Actor (NSA))  
+ 2 \* (Number of Average Actor (NAA))  
+ 3 \* (Number of Complex Actor (NCA))**

Actor Complexity	Example	Actor Weight
Simple	A System with defined API	1
Average	A System interacting through a Protocol	2
Complex	A User interacting through GUI	3

Actor Complexity	Actor Weight	Number of Actors	Product
Simple	1	NSA	$1 \times \text{NSA}$
Average	2	NAA	$2 \times \text{NAA}$
Complex	3	NCA	$3 \times \text{NCA}$
Unadjusted Actor Weight (UAW)			$1 \times \text{NSA} + 2 \times \text{NAA} + 3 \times \text{NCA}$

# Unadjusted Use Case Points (UCPs)

**Step 3 : Calculate Unadjusted Use Case Points**

**Unadjusted Use-Case Points (UUCP) =**

**Unadjusted Use-Case Weight (UUCW) + Unadjusted Actor Weight (UAW).**

# Technical Complexity

Consider the **13 Factors** that contribute to the impact of the Technical Complexity of a project on Use-Case Points and their corresponding Weights as given in the following table:

Factor	Description	Weight
T1	Distributed System	2.0
T2	Response time or throughput performance objectives	1.0
T3	End user efficiency	1.0
T4	Complex internal processing	1.0
T5	Code must be reusable	1.0
T6	Easy to install	.5
T7	Easy to use	.5
T8	Portable	2.0
T9	Easy to change	1.0
T10	Concurrent	1.0
T11	Includes special security objectives	1.0
T12	Provides direct access for third parties	1.0
T13	Special user training facilities are required	1.0

# Technical Complexity

## ■ Calculate the rated value of each factor :

For each of the 13 Factors, assess the project and rate from **0** (irrelevant) to **5** (very important)

## ■ Calculate the Impact of the Factor

Impact of the Factor = Impact Weight (from the table) \* Rated Value

$$I = W \times R$$

- Calculate the sum of Impact of all the Factors. This gives the Total Technical Factor (TFactor):

$$\text{TFactor} = \sum \text{Impact of all factors.}$$

- Calculate the Technical Complexity Factor (TCF) as:

$$\text{TCF} = 0.6 + (0.01 \times \text{TFactor})$$

# Environmental Complexity

Consider the **8 Factors** that contribute to the impact of the Environmental Complexity of a project on Use-Case Points and their corresponding Weights as given in the following table:

Factor	Description	Weight
F1	Familiar with the project model that is used	1.5
F2	Application experience	.5
F3	Object-oriented experience	1.0
F4	Lead analyst capability	.5
F5	Motivation	1.0
F6	Stable requirements	2.0
F7	Part-time staff	-1.0
F8	Difficult programming language	-1.0

# Environmental Complexity

## ■ Calculate the rated value of each factor :

For each of the 8 Factors, assess the project and rate from 0 (irrelevant) to 5 (very important)

## ■ Calculate the Impact of the Factor

Impact of the Factor = Impact Weight (from the table) \* Rated Value

$$I = W \times R$$

## ■ Calculate the sum of Impact of all the Factors. This gives the Total Technical Factor (TFactor):

$$T\text{Factor} = \sum \text{Impact of all factors.}$$

## ■ Calculate the Environmental Complexity Factor (EF) as:

$$EF = 1.4 + (-0.03 \times T\text{Factor})$$

# Adjusted Use Case Points (UCPs)

## ■ Calculate Adjusted Use Case Points

**Adjusted Use-Case Points (UCP) =**

**Unadjusted Use-Case points (UUCP) \* Technical Factor (TCF) \***  
**Environmental Factor (EF).**

# Advantages of Use-Case Points

## Advantages:

- ❖ UCPs are based on use cases and can be measured very early in the project life cycle.
- ❖ UCP (size estimate) will be independent of the size, skill, and experience of the team that implements the project.
- ❖ UCP based estimates are found to be close to actuals when estimation is performed by experienced people.
- ❖ UCP is easy to use and does not call for additional analysis.
- ❖ Use cases are being used vastly as a method of choice to describe requirements. In such cases, UCP is the best suitable estimation technique.

# Disadvantages of Use-Case Points

## Disadvantages:

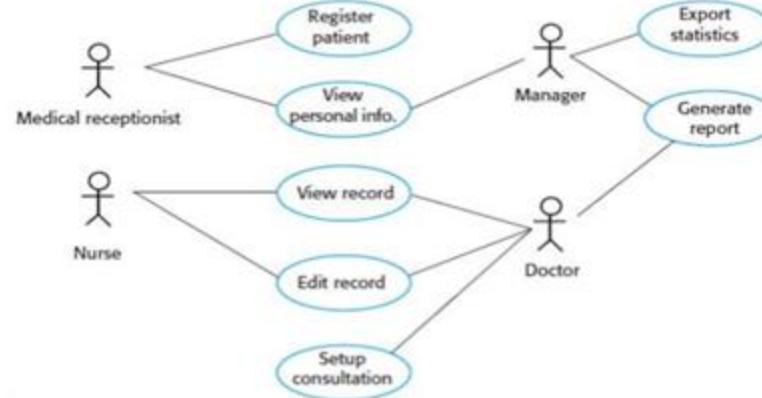
- ✧ UCP can be used only when requirements are written in the form of use cases.
- ✧ Dependent on goal-oriented, well-written use cases. If the use cases are not well or uniformly structured, the resulting UCP may not be accurate.
- ✧ Technical and environmental factors have a high impact on UCP.

Care needs to be taken while assigning values to the technical and environmental factors.

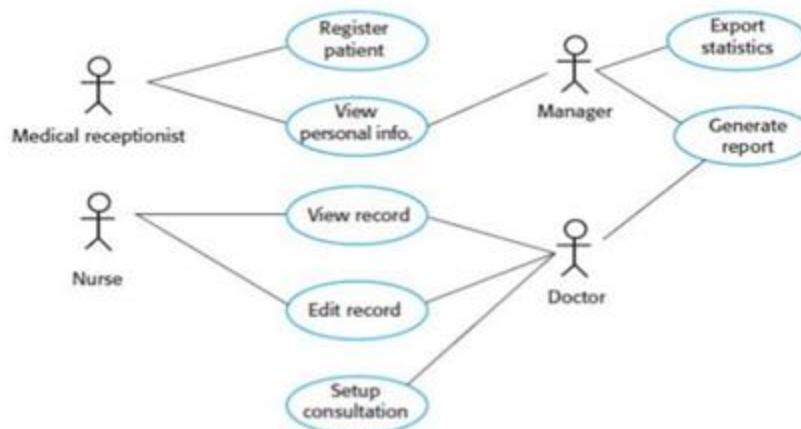
- ✧ UCP is useful for initial estimate of overall project size but they are much less useful in driving the iteration-to-iteration work of a team.

## Example 1

In the use cases of the **mental care system** given that the use cases **View patient information**, and **View record** are simple use cases, **Register patient**, **Edit record** and **Export statistics** are average use cases, **Setup consultation**, and **Generate report** are complex use cases. The **Medical receptionist** and **Nurse actors** are interacting with the system through **API** while the **Manager**, and **Doctor** Use cases are interacting through **GUI**. Calculate the **Unadjusted use case points for this system (UUCP)**.



# Solution



**Solution :**

**Unadjusted use case weight (UUCW) =  $5 * \text{NSUC} + 10 * \text{NAUC} + 15 * \text{NCUC}$**

$$\text{UUCW} = (5 * 2) + (10 * 3) + (15 * 2) = 10 + 30 + 30 = 70$$

**Unadjusted Actor weight (UAW) =  $1 * \text{NSA} + 2 * \text{NAA} + 3 * \text{NCA}$**

$$\text{UAW} = (1 * 2) + (2 * 0) + (3 * 2) = 2 + 0 + 6 = 8$$

**Unadjusted Use-Case Points (UUCP) = UUCW + UAW**

$$\text{UUCP} = 70 + 8 = 78 \text{ use case points}$$

## Example 2

Consider the **13 Factors** that contribute to the impact of the Technical Complexity of a project on Use-Case Points and their corresponding Weights as given in the following table:

For the **mentcare system** if you know that the code must be reusable, and the application should be easy to install, use, and change. Also the application should be portable and include special user training facilities. Estimate the rated values for the relevant factors and calculate the total technical factor TFactor and then calculate the Technical Complexity Factor (TCF) as:  
**TCF = 0.6 + (0.01 × TFactor)**

Factor	Description	Weight
T1	Distributed System	2.0
T2	Response time or throughput performance objectives	1.0
T3	End user efficiency	1.0
T4	Complex internal processing	1.0
T5	Code must be reusable	1.0
T6	Easy to install	.5
T7	Easy to use	.5
T8	Portable	2.0
T9	Easy to change	1.0
T10	Concurrent	1.0
T11	Includes special security objectives	1.0
T12	Provides direct access for third parties	1.0
T13	Special user training facilities are required	1.0

# Solution

**Solution :**

<i>Factor</i>	<i>Description</i>	<i>Weight (W)</i>	<i>Rated value (RV) (0 to 5)</i>	<i>Impact factor <math>I = W \times RV</math></i>
$T_5$	<i>Code must be reusable</i>	1	5	5
$T_6$	<i>Easy to install</i>	0.5	4	2
$T_7$	<i>Easy to use</i>	0.5	4	2
$T_8$	<i>Portable</i>	2	3	6
$T_9$	<i>Easy to change</i>	1	4	4
$T_{13}$	<i>Special user training facilities are required</i>	1	3	3
<b>Total technical factor TFactor</b>				<b>22</b>

$$\text{Technical Complexity Factor (TCF)} = 0.6 + (0.01 * \text{TFactor})$$

$$\text{TFC} = 0.6 + (0.01 * 22) = 0.82$$

## Example 3

The **8 Environmental Factors** that affect the project execution and their corresponding Weights as given in the following table:

For the **mentcare system** if you know that the developing organization worked in this application domain for long time and the development team is highly motivated and they have some part time staff and the system requirements are stable all along the project. Estimate the rated values for the relevant factors and calculate the total Environment impact Factor (EFactor) and then **calculate the Environmental Factor (EF)** as:  
$$EF = 1.4 + (-0.03 \times EFactor)$$

Factor	Description	Weight
F1	Familiar with the project model that is used	1.5
F2	Application experience	.5
F3	Object-oriented experience	1.0
F4	Lead analyst capability	.5
F5	Motivation	1.0
F6	Stable requirements	2.0
F7	Part-time staff	-1.0
F8	Difficult programming language	-1.0

# Solution

**Solution :**

<i>Factor</i>	<i>Description</i>	<i>Weight (W)</i>	<i>Rated value (RV) (0 to 5)</i>	<i>Impact factor <math>I = W \times RV</math></i>
$F_2$	<i>Application experience</i>	0.5	4	2
$F_5$	<i>Motivation</i>	1	4	4
$F_6$	<i>Stable requirements</i>	2	4	8
$F_7$	<i>Part time staff</i>	-1	3	-3
<i>Total environment factor EFactor</i>				11

$$\text{Environmental Factor (EF)} = 1.4 + (-0.03 * \text{EFactor})$$

$$\text{EF} = 1.4 + (-0.03 * 11) = 1.4 - 0.33 = 1.07$$

## Example 4

**Calculate Adjusted Use-Case Points (UCP) for the mentcare system using previous calculation of UUCP , TCF and EF as:**

$$\text{UCP} = \text{UUCP} * \text{TCF} * \text{EF}$$

**Solution:**

$$\text{UCP} = \text{UUCP} * \text{TCF} * \text{EF}$$

$$\text{UCP} = 78 * 0.82 * 1.07 = \text{68.4372 use case points}$$



# Any Question ?

Next ....