DECISION SUPPORT SYSTEM

MULTI-CRITERIA DECISION MAKING

TEACHING TEAM

DECISION SUPPORT SYSTEM COURSE

Multi-Criteria Decision Making (MCDM)

MCDM

- It is a scientific branch of operations research which deals with decision making based on many criteria
- Determining the best alternative from a number of alternatives based on certain criteria

Sometimes interpreted the same as

MADM

Multi-attributes Decision Making

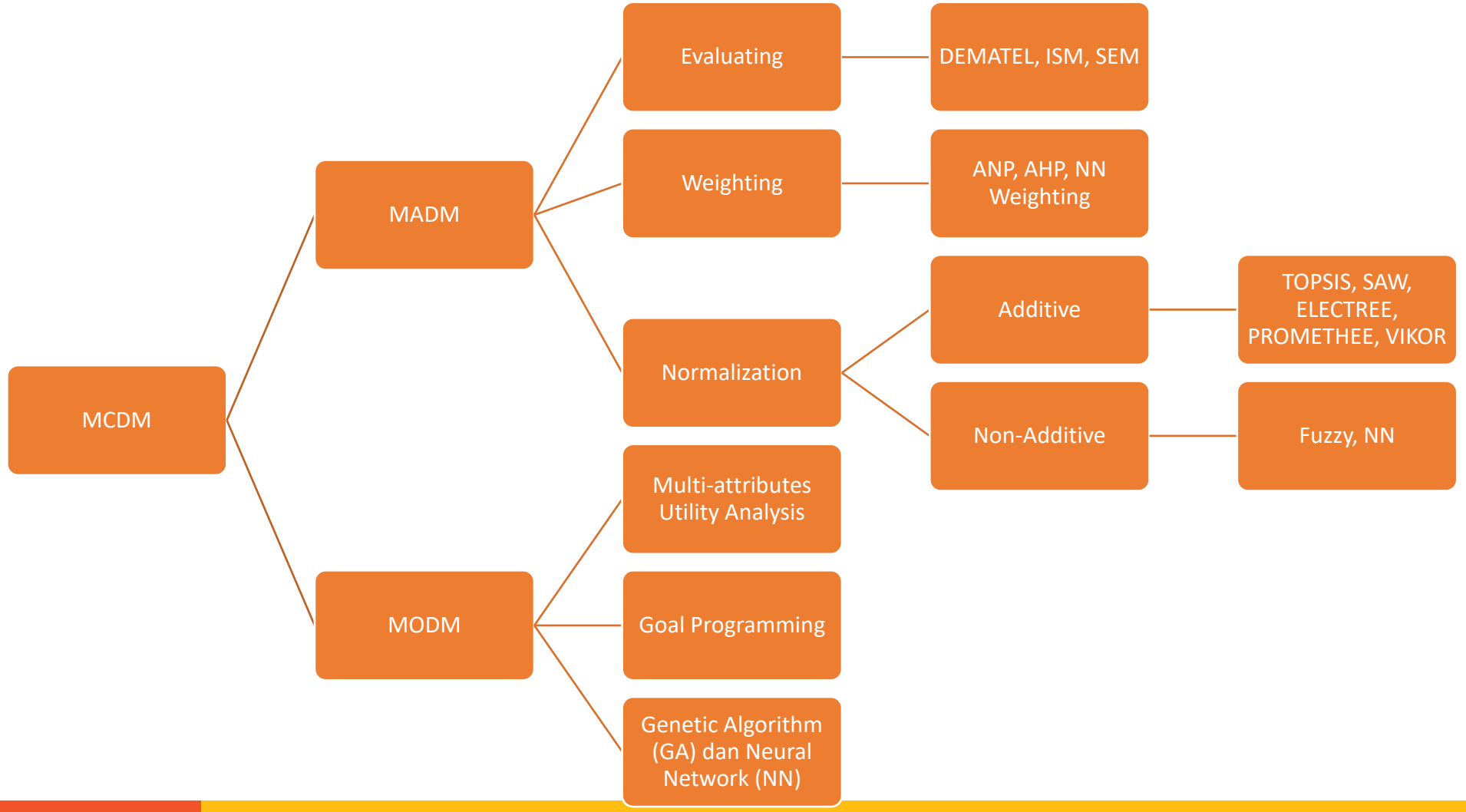
- Problems with discrete decision scope
- Single goal
- Alternatives have been defined beforehand

MODM

Multi-objective Decision Making

- Problems with continuous decision scope
- Many goals
- Alternatives are infinite, because there is an alternative design process within it
- Alternatives are based on specific goals and procedures

MCDM Classification



Concepts in MCDM (1)

Alternative

- The options that will be chosen by the decision maker

Multi Criteria

- Criteria used to determine which alternative will be selected
- Can be arranged in hierarchical form (AHP)

Attribute Conflict / Attribute Type

- Attributes in MCDM very likely represent different dimensions, their values have opposite meanings. Example, expenses (costs) and income (profit)
- So, there are 2 types of attributes in MCDM,
  - Cost, and
  - Benefit

Concepts in MCDM (2)

Different Criteria Units

- The criteria in the MCDM case are very likely to have different units
- Example: Expenditures → Rupiah; Distance → Kilometers

Decision Weight

- Most methods in MCDM use weights to determine the **level of importance** of criteria

Decision Matrix

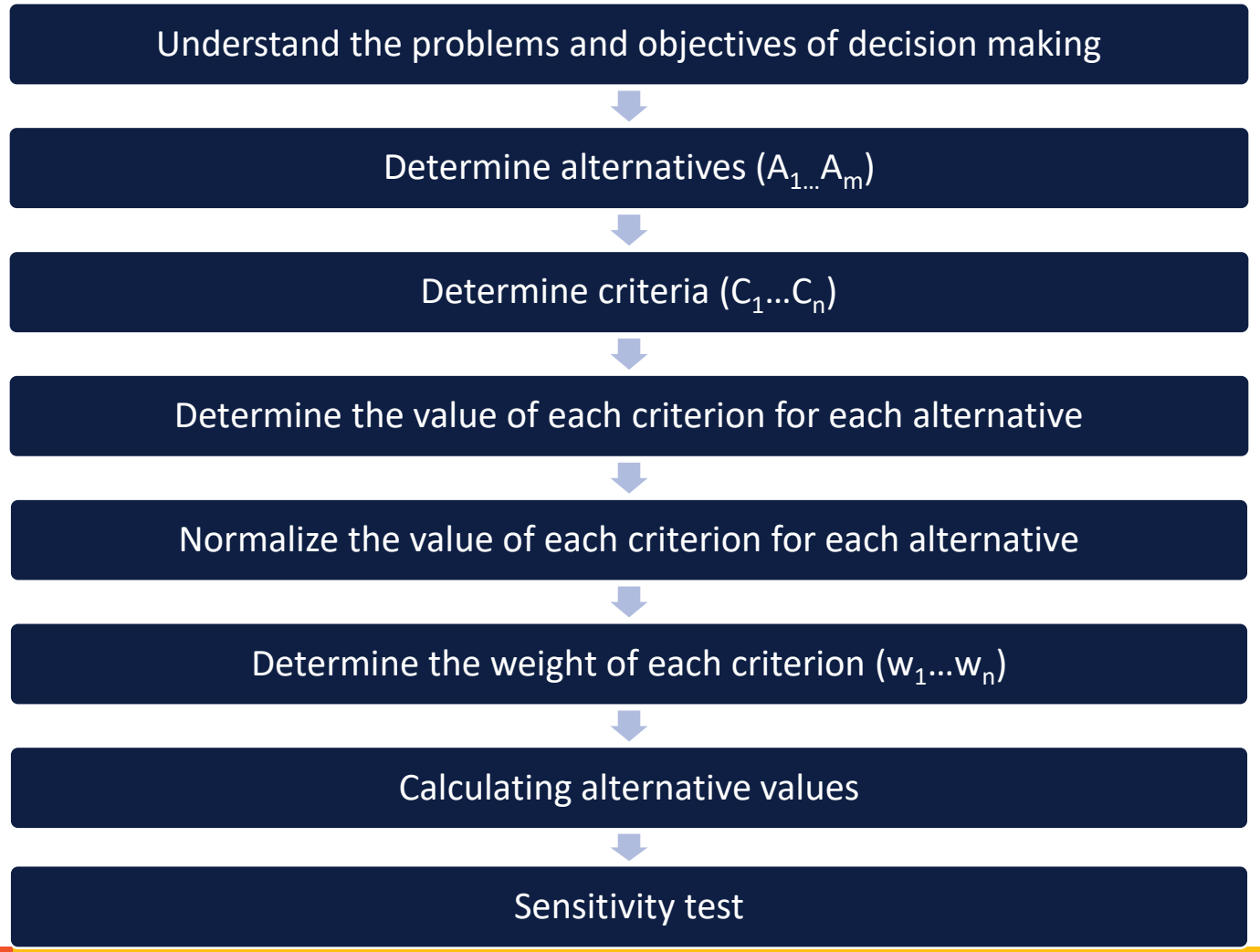
- MCDM uses a decision matrix to represent the relationship between alternatives and the criteria used

Decision Matrix

Alternative	C_1 (w_1	C_2 w_2	… …	C_n w_n)
A_1	r_{11}	r_{11}		r_{1n}
A_2	r_{21}	r_{22}	…	r_{2n}
.	.	.	…	…
.	.	.	…	…
.	.	.	…	…
A_m	A_{m1}	A_{m2}	…	A_{mn}

- C: Criteria
- A: Alternative
- r: Value of the i-th alternative on the j-th criterion

Decision Making Steps in MADM



Normalization Techniques (1)

Normalization Type	Benefit Attribute	Cost Attribute
Simple	$r_{ij} = \frac{S_{ij}}{\max(S_j)}$	$r_{ij} = \frac{\min(S_j)}{S_{ij}}, S_{ij} > 0$
Nijkamp's	$r_{ij} = 1 - \frac{\max(S_j) - S_{ij}}{\max(S_j) - \min(S_j)}$	$r_{ij} = 1 - \frac{S_{ij} - \min(S_j)}{\max(S_j) - \min(S_j)}$
Linear Max	$r_{ij} = \frac{S_{ij}}{\max(S_j)}$	$r_{ij} = 1 - \frac{S_{ij}}{\max(S_j)}$
Linear Max Min	$r_{ij} = \frac{S_{ij} - \min(S_j)}{\max(S_j) - \min(S_j)}$	$r_{ij} = \frac{\max(S_j) - S_{ij}}{\max(S_j) - \min(S_j)}$

$r_{ij} = Normalization\ value\ of\ alternative\ i\ on\ criterion\ j$
$S_{ij} = Original\ value\ of\ alternative\ i\ on\ criterion\ j$
$\max(S_j) = Maximum\ value\ of\ criterion\ j\ from\ all\ alternatives$
$\min(S_j) = Minimum\ value\ of\ criterion\ j\ from\ all\ alternatives$

Normalization Techniques (2)

Normalization Type	Benefit Attribute	Cost Attribute
Linear Sum	$r_{ij} = \frac{S_{ij}}{\sum_1^m S_{ij}}$	$r_{ij} = \frac{1/S_{ij}}{\sum_1^m 1/S_{ij}}$
Vector normalization	$r_{ij} = \frac{S_{ij}}{\sqrt{\sum_1^m S_{ij}^2}}$	$r_{ij} = 1 - \frac{S_{ij}}{\sqrt{\sum_1^m S_{ij}^2}}$

$r_{ij} = Normalization\ value\ of\ alternative\ i\ on\ criterion\ j$
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