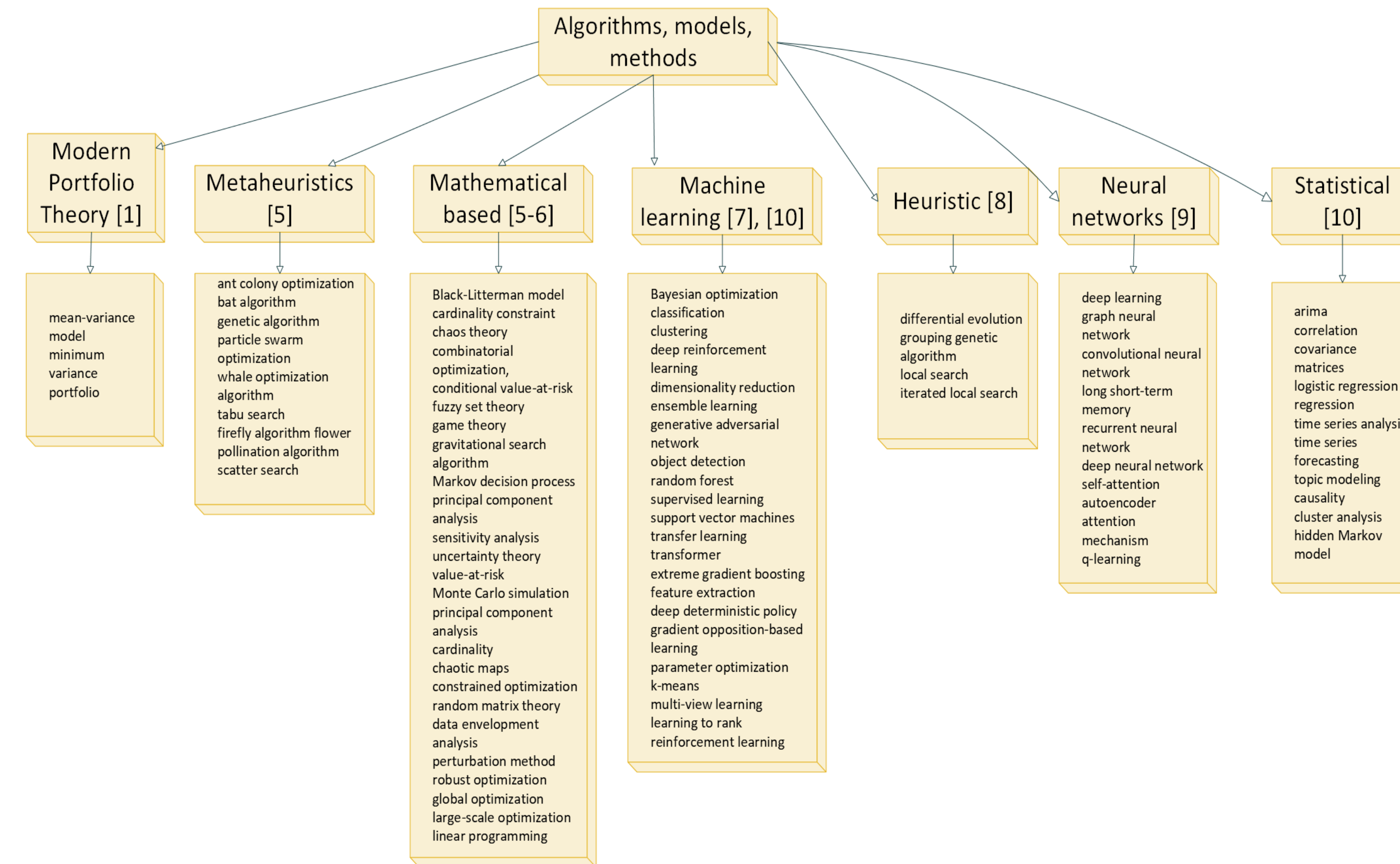


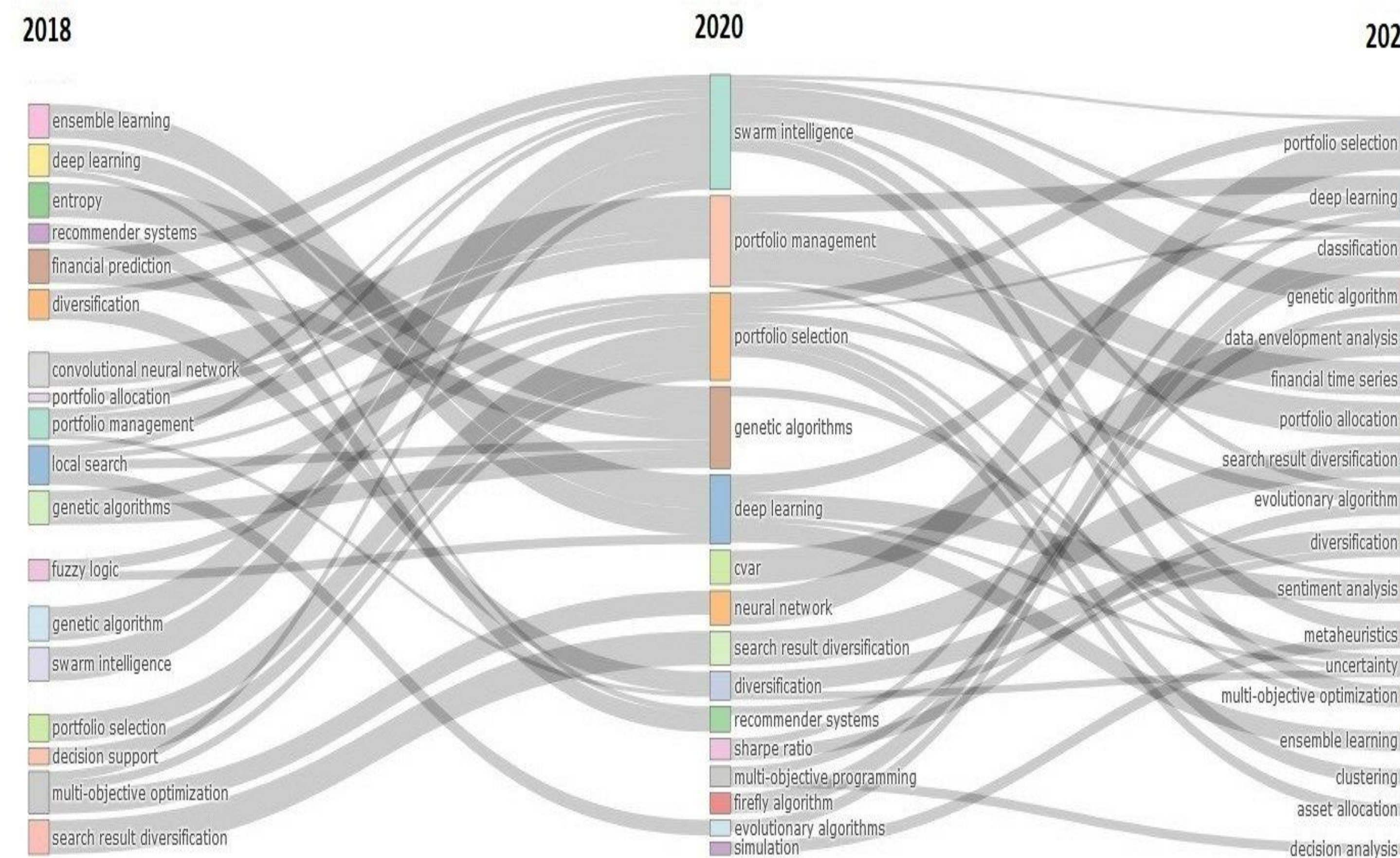
## ABSTRACT

- H. M. Markowitz's groundbreaking Modern Portfolio Theory, introduced in 1952, started a new era in the investment domain. With the ongoing emergence of the fourth industrial revolution, characterized by significant advancements in computing and artificial intelligence, the investment sector has witnessed continuous changes.
- New techniques and methods are continually emerging each year for the formatting of investment portfolios aimed at maximizing profitability while minimizing risk.
- This study unveils and analyses the most recent methodologies employed in crafting investment portfolios over the past five years. The study findings not only show these contemporary approaches but also contribute to enhancing the existing knowledge base surrounding the art of constructing investment portfolios.

## CLASSIFICATION OF CONCEPTS



**Figure 1.** Classification of algorithms, models, and methods for decision making of formation Investment portfolio

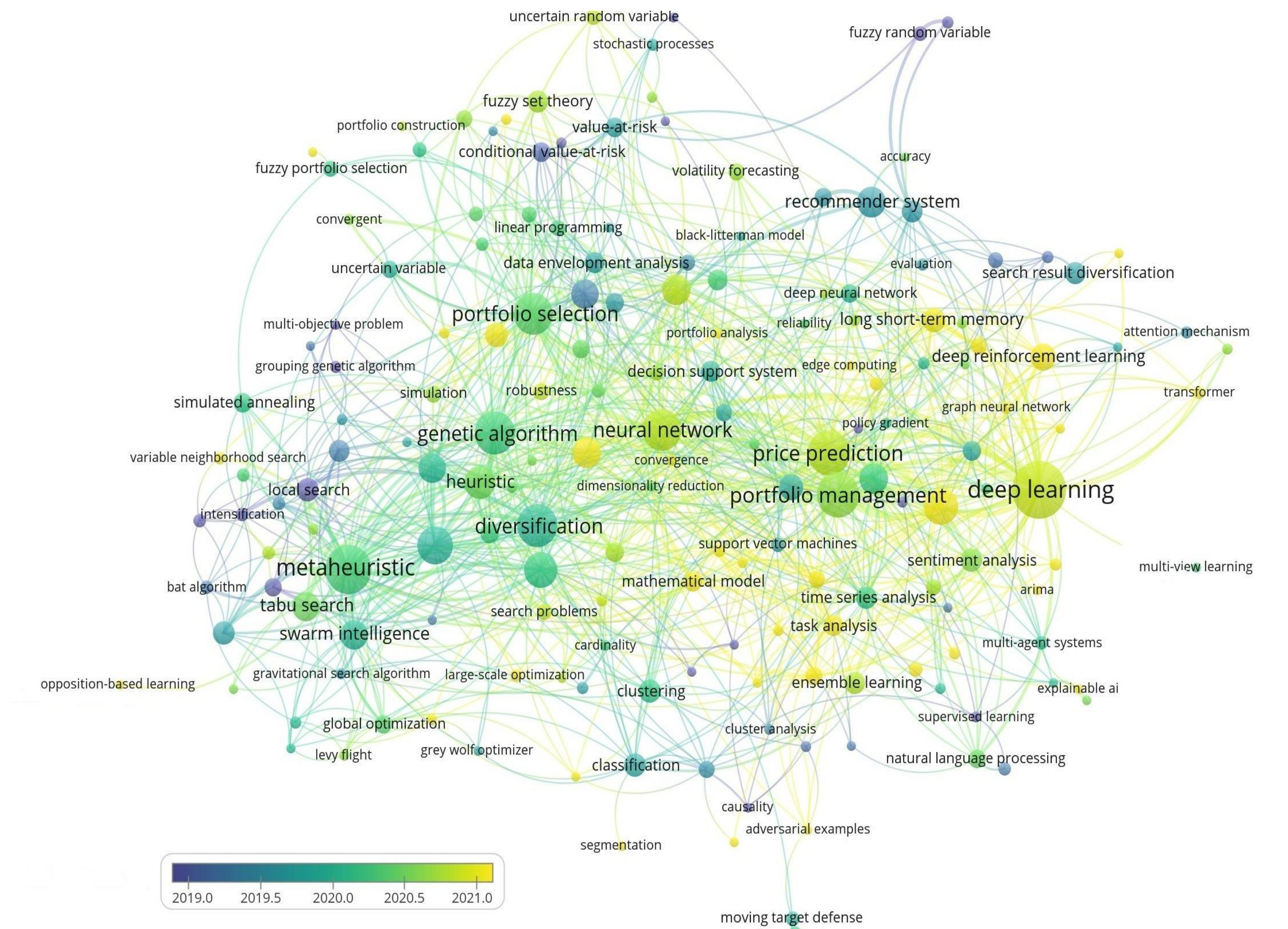


**Figure 2.** The changed topics over time of the found publications

## CONCLUSIONS

- The bibliometric analysis of Investment Portfolio Decision-Making shows a trend of methods, models, and algorithms that appeared in the last five years [2018 – 1st November of 2023].
- The keywords map and the chronological analysis of algorithms, methods, and models for investment portfolio decision-making show a growing interest in this topic and their application in new approaches for more effective portfolio optimization.

## BIBLIOMETRIC ANALYSIS



**Figure 3.** Keyword map of investment portfolio optimization models and methods

## METHODS

- Chronological occurrence analysis (CHOA)  
*When and what types of algorithms, models, and decision-making methods appeared in publications to construct investment portfolios?*
- Bibliometric analysis (Biba)  
*What are the visible trends for algorithms, models, and decision-making methods to construct investment portfolios' appearance?*

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## BACKGROUND

**Definition 1.** Modern Portfolio Theory [1-3] is a mathematical-based investment theory for the formation and optimization of investment portfolios. It was developed by Harry Markowitz.

The **Markowitz model** considers the expected return and risk of investments, where the expected return of the portfolio (ERp) is based on the weight (Wi) of each investment, the expected return of each investment (ERi), and the number of instruments in the portfolio (N):

$$ER_p = \sum_{i=1}^N W_i ER_i$$

The calculation of the risk of the portfolio starts with the calculation of covariance between the assets Ri and Rj:

$$Cov(R_i, R_j) = \sum_{k=1}^n p_k (R_{i,k} - R_i)(R_{j,k} - R_j)$$

The **correlation coefficient** [4] is the relationship between the quantities R1 and R2 and by their variance:

$$cor(R_1, R_2) = Cov(R_1, R_2) \div \sigma_{R_1} \times \sigma_{R_2}$$

The **standard deviation** is the risk of the investment portfolio:

$$\sigma_p^2 = \sum_{i=1}^n W_i^2 \sigma_i^2 + \sum_{i=1}^n \sum_{j=1}^n W_i W_j Cov_{ij}$$

**Definition 2.** The investment portfolio is a collection of financial investments like stocks, bonds, cash, and commodities. The investment portfolio is used to achieve financial goals, to buy a home, for retirement money, for the education of children and others.

**Definition 3.** Portfolio management refers to making decisions about investments, how to allocate assets in the portfolio, and balancing risk against return. This is the continuous process of selecting and managing a basket of investments that meet long-term financial objectives.

**Definition 4.** Portfolio optimization is a method or group of methods used in finance to select the best portfolio, out of all possible portfolios, and consider, according to some goals. The main goal is to maximize return and minimize financial risk.

**Definition 5.** Decision-making is the cognitive process of selecting a course of action from among multiple alternatives. Effective decisions encompass identifying, evaluating, and choosing between alternatives.