**Graphs are discrete structures consisting of vertices and edges that connect these vertices. There are different kind sof graphs,depending on whether edges have directions,whether multiple edges can connect the same pair of vertices, and whether loops are allowed. Problems in almost every conceiv able discipline can be solve dusing graph models.We will give examples toi llustrate how graphs are used as models in a variety of areas.Forinstance,we will show how graphs are used to represent the competition of different species in an ecological niche, how graphs are used to represent who inﬂuences whom in an organization, and how graphs are used torepresenttheoutcomesofround-robintournaments.Wewilldescribehowgraphscanbeused tomodelacquaintanceshipsbetweenpeople,collaborationbetweenresearchers,telephonecalls betweentelephonenumbers,andlinksbetweenwebsites.Wewillshowhowgraphscanbeused to model roadmaps and the assignment of jobs to employees of an organization. Using graph models, we can determine whether it is possible to walk down all the streets in a city without going down a street twice, and we can ﬁnd the number of colors needed to color the regions of a map. Graphs can be used to determine whether a circuit can be implementedonaplanarcircuitboard.Wecandistinguishbetweentwochemicalcompoundswiththe same molecular formula but different structures using graphs. We can determine whether two computers are connected by a communications link using graph models of computer networks. Graphs with weights assigned to their edges can be used to solve problems such as ﬁnding the shortestpathbetweentwocitiesinatransportationnetwork.Wecanalsousegraphstoschedule exams and assign channels to television stations.This chapter will introduce the basic concepts ofgraphtheoryandpresentmanydifferentgraphmodels.Tosolvethewidevarietyofproblems that can be studied using graphs, we will introduce many different graph algorithms. We will also study the complexity of these algorithms.**