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Selection of programme slots of television channels for giving advertisement: A graph theoretic approach

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Abstract

The present paper aims at developing a linear time algorithm to find a solution to the 'maximum weight 1 colouring' problem for an interval graph with interval weight. This algorithm has been applied to solve the problem that involves selecting different programme slots telecast on different television channels in a day so as to reach the maximum number of viewers. It is shown that all programmes of all television channels can be modelled as a weighted interval graph with interval numbers as weights. The programme slots are taken as the vertices of the graph and if the time durations of two programme slots have non-empty intersection, the corresponding vertices are considered to be connected by an edge. The number of viewers of a programme is taken as the weight of the vertex. In reality, the number of viewers of a programme is not a fixed one; generally, it lies in an interval. Thus, the weights of the vertices are taken as interval numbers. We assume that a company sets the objective of selecting the popular programme in different channels so as to make its commercial advertisement reach the maximum number of viewers. However, the constraint imposed is that all selected programmes are mutually exclusive in respect of time scheduling. The objective of the paper is, therefore, to helps the companies to select the programme slots, which are mutually exclusive with respect to the time schedule of telecasting time, in such a way that the total number of viewers of the selected programme slots rises to the optimum level. It is shown that the solution of this problem is obtained by solving the maximum weight colouring problem on an interval graph. An algorithm is designed to solve this optimization problem using $O(n)$ time, where n represents the total number of programmes of all channels.

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1. Introduction

Today television has acquired the central position in all our entertainments. Television is not only the most popular technological device of entertainment but it is also the best medium for sending information in the simplest way. Various production units and advertisement agencies use the electronic media such as the television to market their products and/or services to the existing and prospective consumers. The companies normally prefer this medium to many other media since through this medium they can demonstrate the superiority of their products over others' products, and thereby can attract the attention of the prospective buyer/viewers, which, more often than not, leads to an increase in the sale of their products. Under such situations, the larger the number of viewers, the greater will be the prospect of sale of the product. The objective of our study is thus to select those programmes from amongst all programmes shown on different channels which would attract maximum number of viewers.

Now we observe that there are more than hundred channels like BBC World, CNN, HBO, STAR, ESPN, DISCOVERY, ANIMAL PLANET, ZEE, MGM, NATIONAL GEOGRAPHIC, AXN etc., running programmes round the clock. Some of these programmes are very popular and have very high viewer ratings. Few such programmes are 'Guiness World Record Prime Time' at 9:00 a.m. shown on AXN, 'Charlie Chaplin' at 9:00 a.m. on ZEE ENGLISH, 'Mission Everest' at 10:00 a.m. on National Geographic channel, etc. For the producer of consumer goods the problem is to choose programmes from among a host of programmes being televised by different channels that will have maximum viewer coverage. If in a single time slot the viewer coverage is maximum for a single programme, then the choice of the programme for beaming the commercial advertisement becomes simple. However, if two or more programmes shown on different channels on a particular time slot are equally popular and attract large number of viewers, the advertising company perhaps could have chosen all of them to fulfill its objective of maximizing the number of viewers. But it will involve a huge cost. Therefore, it is out of consideration by the advertising company having limited fund. This is implied in the assumption of mutual exclusiveness of chosen programmes at a particular slot, made earlier.

The algorithm is based on a weighted interval graph analysis with interval numbers as weight of the vertices. In the remaining part of this section we explain the essence of the interval graph and interval numbers that we have used.

Now-a-days most of the channels run for 24 h a day. Let us suppose the BBC has programmes as per the following schedule: a movie during 7:00–8:00 h, news during 8:00–8:30 h and so on. Similarly, CNN runs its programmes, say, a movie during 0:00–3:00 h, a serial during 3:00–4:00 h and so on. All other channels have their programmes scheduled on different slots like this. For graphical representation, each time slot or programme is considered as an interval on a real axis. The interval can be represented as closed interval $[a_i, b_i]$, where a_i and b_i represent the starting and finishing time of the programme respectively.

Each programme slot of a particular channel can thus be represented as an interval on 0–24 h time interval. Thus the programme slots of all the channels can be represented as a collection of intervals on the line segment $[0, 24]$. Each interval has a weight which is equal to the number of viewers watching the programme. However, the number of viewers of a programme keeps on changing with the change in the theme of the episodes. This creates problems with regard to the determination and assignment of weights. In such a situation the weight is expressed as an interval number instead of crisp number.

The set of programme schedule form a weighted interval graph G, whose vertex weights are interval numbers. An *interval graph* is a graph whose vertices can be mapped into unique intervals on the real line so that the two vertices in the graph are adjacent if and only if their corresponding intervals intersect. An interval graph is called weighted if its vertices have weights. It will be shown that the maximum number of viewers of some disjointed programme slots is equal to the weight of the 1-colourable subgraph of the interval graph G. Thus, this problem can be modelled as an interval graph.

Interval graphs have been extensively studied and used as models for many real world problems. The interval graph is one of the most useful discrete mathematical structure for modelling problems arising in the real world. It has many applications in various fields like archeology, molecular biology, genetics, psychology, computer scheduling, storage information retrieval, electric circuit design, traffic planning, VLSI design etc. [15,29]. Interval graphs have been studied from both the theoretical and algorithmic points of view.