Smart TV Scheduling in Public Venues

This problem statement challenges participants to design a broadcast schedule that maximizes viewer satisfaction by selecting the most relevant and engaging programs across multiple TV channels – under real-world constraints typical of cafes, lounges, and other shared public spaces.

Introduction

TV programs can entertain, inform, and bring people together — especially in shared public spaces like cafes, lounges, gyms, and waiting areas. Whether it's catching up on the news, enjoying a sports match, or listening to music videos, television content shapes the atmosphere of these venues and influences how people experience their time there.

This problem embraces the challenge of bringing smarter, more engaging content to public screens. It reflects a growing need to tailor what's broadcast based on viewer preferences, content popularity, and context — such as time of day and the expected audience type. By carefully selecting what gets shown and when, venue operators can improve satisfaction and make better use of their media setups.

In this competition problem, we explore the challenges of creating an optimal TV schedule that runs throughout the day. Participants must choose which programs to show, when to show them, and from which channels — all while navigating real-world constraints such as content contracts, audience preferences, and program interruptions. The objective is to maximize overall viewer satisfaction through intelligent scheduling.

Task

Given a description of multiple TV channels and their scheduled programs, determine which programs to display on a single screen throughout the day to maximize overall viewer satisfaction. The schedule must cover the entire interval between the venue's opening and closing hours.

Problem description

Channels

There are C different TV channels, each identified by a unique channel ID from 0 to C – 1. Each channel broadcasts a list of programs. A program is characterized by the following properties:

- A unique program ID (a string)
- A start time and an end time, expressed in minutes from the beginning of the day
- A genre (e.g., news, sports, music)
- A popularity score (an integer)

Each program belongs to exactly one channel, and no two programs on the same channel overlap in time. All program times fall within the global time window defined by the venue's opening and closing hours.

Time

The schedule must cover a continuous time window between minute O and minute E, where all values are given in minutes from the beginning of the day (minute 0). Minute O (opening time) marks the first minute when a program may be displayed, and minute E – 1 (closing time) is the last minute during which a program may be shown.

Additionally, there are I preferred time intervals defined in the input. Each preferred interval is specified by a start and end time (both in minutes), a preferred genre G, and a bonus value B. If a program of genre G is scheduled within the corresponding interval, the bonus value B is added to the total score. Multiple bonuses may be applied if multiple preferred intervals are satisfied.

Channel constraints

There are P priority time blocks during which only a subset of channels may be displayed. Each such block is defined by a start and end time (in minutes) and a list of allowed channel IDs. During these blocks, only programs from the specified channels may be scheduled.

Switching from one channel to another between two consecutive programs results in a penalty of –S points per switch. In addition, if a scheduled program is terminated before its specified end time, a penalty of –T points is incurred for each early termination. Likewise, if a program is switched to after its scheduled start time, a penalty of –T points is applied for the delay.

To ensure genre diversity, there is a limit of R on the maximum number of consecutive programs with the same genre that may appear in the schedule.

Scheduling

The task is to construct a valid schedule by selecting a subset of programs that satisfy all of the following conditions:

- The programs must not overlap in time.
- No more than R consecutive programs may share the same genre.
- During each priority time block, only programs from the specified allowed channels may be scheduled.
- Each scheduled program must have a continuous duration of at least D minutes, without interruptions caused by channel changes. In cases where the overall duration of a program is less than D minutes, the scheduled duration must equal the program's original planned duration.
- All scheduled programs must start no earlier than O and end no later than E.

The objective is to maximize the total score, as defined in the Scoring section.

Figure 1illustrates the process of selecting programs from different channels in a public venue scenario. The venue operates on a 9-hour scheduling window (9:00 AM – 6:00 PM) across three channels: News (Channel 0), Sports (Channel 1), and Music (Channel 2). Key decision factors include program popularity scores, channel switching penalties (–5 points), genre diversity constraints (a maximum of two consecutive programs of the same genre), and minimum duration

requirements (≥30 minutes). The example highlights the decision point at 10:00 AM, where the Soccer Match (net score: 95 points) is selected over Pop Hits (net score: 55 points) based on overall score. The process continues iteratively until the venue's closing time, aiming to maximize total viewer satisfaction while meeting all operational constraints.

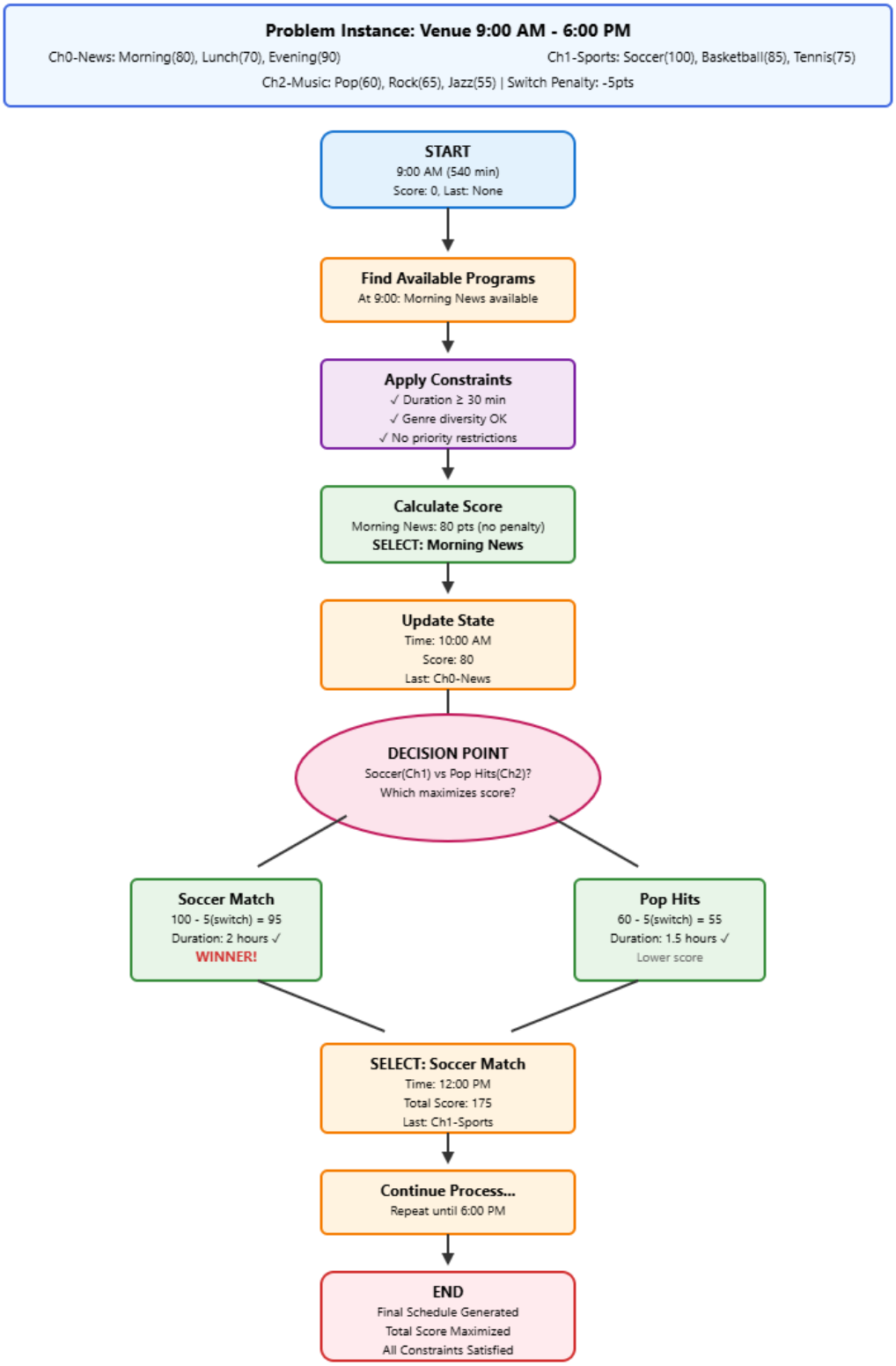

Figure 1: Figure 1: Decision flow for a three-channel instance of the Smart TV Scheduling in Public Venues problem.[1]

Input data set

The input is provided in a plain text file. The file contains only ASCII characters, with each line ending in a single \n character (UNIX-style line endings). Multiple values on a single line are separated by a single space.

All time intervals are defined as half-open: the start time is inclusive, and the end time is exclusive.

The first line of the input contains seven integers:

- an integer O (0 <= O <= 44,640) – the opening time of the venue in minutes from the start of the day
- an integer E (1 <= E <= 44,640) – the closing time of the venue in minutes from the start of the day
- an integer D (1 <= D <= 120) – the minimum allowed duration for a scheduled program
- an integer R (1<= R <= 44,640) – the maximum number of consecutive programs with the same genre
- an integer C (1<= C <= 50,000) – the number of available TV channels
- an integer S (0 ≤ S ≤ 1000) — the penalty (in points) subtracted each time the schedule switches from one channel to a different channel
- an integer T (0 ≤ T ≤ 1000) — the penalty (in points) subtracted each time a program is terminated before its official end time or switched to after its scheduled start time.

The second line contains an integer P – the number of priority time blocks.

The next P lines each describe a priority time block with the following format:

- an integer S_B (0 <= S_B <= E) – the start time of the block
- an integer E_B (S_B < E_B <= E) – the end time (exclusive) of the block
- an integer K (1 <= K <= C) – number of allowed channels
- a sequence of K integers C_1, C_2, …, C_k (0 <= C_i < C) – the allowed channel IDs (space-separated)

The next line contains an integer I – the number of time preference intervals.

The next I lines each describe a time preference interval in the format:

- an integer S_T (0 <= S_T <= E) – start time of the interval
- an integer E_T (0 <= E_T <= E) – end time (exclusive) of the interval
- a string G – the preferred genre
- an integer B (1<= B <=1000) – the bonus score awarded if a program of genre G is scheduled in this interval

The next C blocks describe the available programs for each channel. Each block begins with a line:

[1] Figure generated with Claude.ai

- an integer N (1 <= N <= 3000) – the number of programs on this channel

This is followed by N lines, one for each program, with the following format:

Table 1: Sample input file format for the Smart TV Scheduling problem

Input file	Description
540 1080 30 2 3 5 10	Venue open from 9 AM (540) to 6 PM (1080), min program duration 30 min, max 2 consecutive same-genre, 3 channels, channel switch penalty is 5, early termination penalty is 10
1	Number of priority time blocks
720 780 2 0 2	Priority block from 12 PM–1 PM (720–780), allowed channels 0 and 2
2	Number of time-preference intervals
540 720 news 50	Preferred genre news from 9–12 PM (540–720), bonus 50
720 900 sports 40	Preferred genre sports from 12–3 PM (720–900), bonus 40
2	Channel 0 has 2 programs
n1 540 600 news 80	Program n1 on Ch0: 9–10 AM (540–600), genre news, score 80
n2 600 660 documentary 70	Program n2 on Ch0: 10–11 AM (600–660), genre documentary, score 70
2	Channel 1 has 2 programs
s1 720 840 sports 100	Program s1 on Ch1: 12–2 PM (720–840), genre sports, score 100
s2 840 960 sports 90	Program s2 on Ch1: 2–4 PM (840–960), genre sports, score 90
1	Channel 2 has 1 program
m1 960 1020 music 60	Program m1 on Ch2: 4–5 PM (960–1020), genre music, score 60

- a string ID – a unique program ID
- an integer S_P (0 <= S_P <= E) – the start time (in minutes)
- an integer E_P (0 <= E_P <= E) – the end time (exclusive) in minutes
- a string G – the genre name
- an integer SCORE (0 <= SCORE <= 1000) – the popularity score

Table 1 shows a sample input for the small problem instance with three TV channels. Although the example above includes blank lines for readability, actual instance files are delivered as JSON—without any blank lines—to ensure both clarity and portability.

Submissions

File format

Your submission describes the full schedule as a single ordered list of programs. A channel (and any given program) may appear multiple times.

The submission file must start with the first line containing the integer P (0 ≤ P) – the total number of scheduled programs.

Then the file must contain P lines. Each line – in the exact broadcast order – must contain two values:

- Y (0 ≤ Y ≤ C – 1) — the channel ID
- ID — the program's unique identifier (a string)

Notes

- You don't need to repeat start/end times—those come from the input.
- Any listing that would start at or after closing time E is ignored.
- Programs that overlap, start before O, or end at/after E are ignored.
- Gaps between programs are allowed (they simply earn no score).
- All scoring rules (switch penalties, early-termination penalties, genre limits, bonuses) apply over the implied schedule.

In Table 2, we present a valid solution for the input instance, scheduling four programs in strict accordance with every constraint. We begin with n1 on Channel 0 from 9:00–10:00 AM, followed by n2 on Channel 0 from 10:00–11:00 AM. We then leave a gap from 11:00 AM–2:00 PM to avoid the 12:00–1:00 PM priority block (which only permits Channels 0 and 2) and to respect program availability. At 2:00 PM we resume with s2 on Channel 1 (2:00–4:00 PM), and finish with m1 on Channel 2 from 4:00–5:00 PM, leaving an idle slot until closing at 6:00 PM. Any programs that would overlap, fall outside the 9:00 AM–6:00 PM window, or violate the priority block have been omitted.

Table 2: Sample submission file format for the Smart TV Scheduling problem

Submission file	Description
4	Four programs will be displayed in sequence.
0 n1	Channel 0 → program n1 (9:00–10:00 AM)
0 n2	Channel 0 → program n2 (10:00–11:00 AM)
1 s2	Channel 1 → program s2 (2:00–4:00 PM)
2 m1	Channel 2 → program m1 (4:00–5:00 PM)

Please note that you can also generate the output file in JSON format, following the schema that will be provided by the organizers alongside the input test set.

Scoring

Your submission will be evaluated by computing a total score according to the following formula:

Total Score = + ∑ (scheduled program scores) + ∑ (applicable time-block bonuses)

– S × (number of channel switches) – T × (number of early terminations+ late switches)

More specifically, your total score is computed as follows: for each program you schedule, you earn its popularity score, and if that program falls within a preferred time interval matching its genre, you also collect the interval's bonus. Note that in order to collect the bonus, the program must fall within the preferred interval with at least the minimum scheduled duration D. Further, every time you switch from one channel to another you incur a penalty of S points, and any program you terminate early or switch to after its start costs you T points. The values of S and T are specified on the first line of the input file.

Table 3 presents a step-by-step example of how the Total Score is computed for the four-program schedule.

Table 3: Detailed score breakdown for the sample schedule

Program	Channel	Time	Base Score	Bonus	Subtotal
n1	0	9:00–10:00	80	50	130
n2	0	10:00–11:00	70	0	70
s2	1	2:00–4:00	90	40	130
m1	2	4:00–5:00	60	0	60

Putting it all together, we start with 300 base points, add 90 bonus points, subtract 10 points for two channel switches, and incur no early-termination penalties—yielding a final score of 380.