

# MASTER OF TECHNOLOGY USER GUIDE

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BTO Recommender system

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## TEAM MEMBERS

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GANESH KUMAR - 4

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MASTER OF TECHNOLOGY



# BTO Recommender System

## User Guide

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## REQUIREMENTS:

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### RECOMMENDED BROWSERS

BTO Recommender system supports the following Web Browsers::

- Internet Explorer 11
- Microsoft Edge 39 and above
- Firefox 53 and 52 ESR and above
- Google Chrome Version 59 and above
- Safari Version 10 and above

### SYSTEM OVERVIEW

Our HDB BTO Recommender system is a Web information system, which is generally targeted at young Singaporean couples looking to purchase their first property and set up a family. The website will ask a series of question, and generate the most appropriate HDB unit that fits the user requirements.

### USER INTERFACE

Our user interface runs in Python. Once our inference engine outputs the result, the result would be sent to python which then queries the most appropriate HDB unit from the database, and displays the results onto the web interface.

### DEPLOYMENT

Our System is deployed in an Ubuntu server 16.04.4. In order to run the system, you will need to have a working Python installation with the necessary libraries installed:

- python-clips (install using apt-get)
- flask
- flask-socketio
- eventlet
- simplejson
- panda

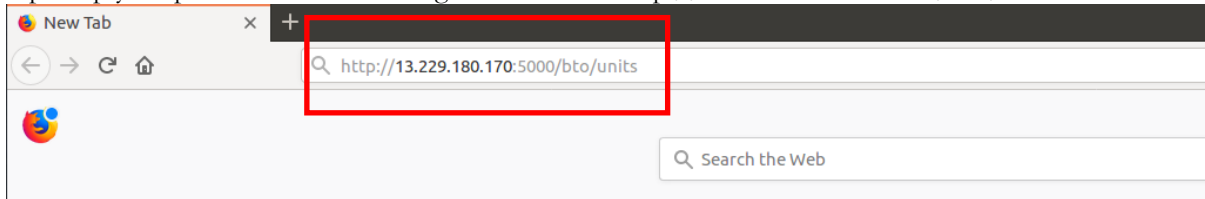
To install the libraries above, key in the command “pip install <library’s name>”.

To run our system, simply open a terminal, enter:

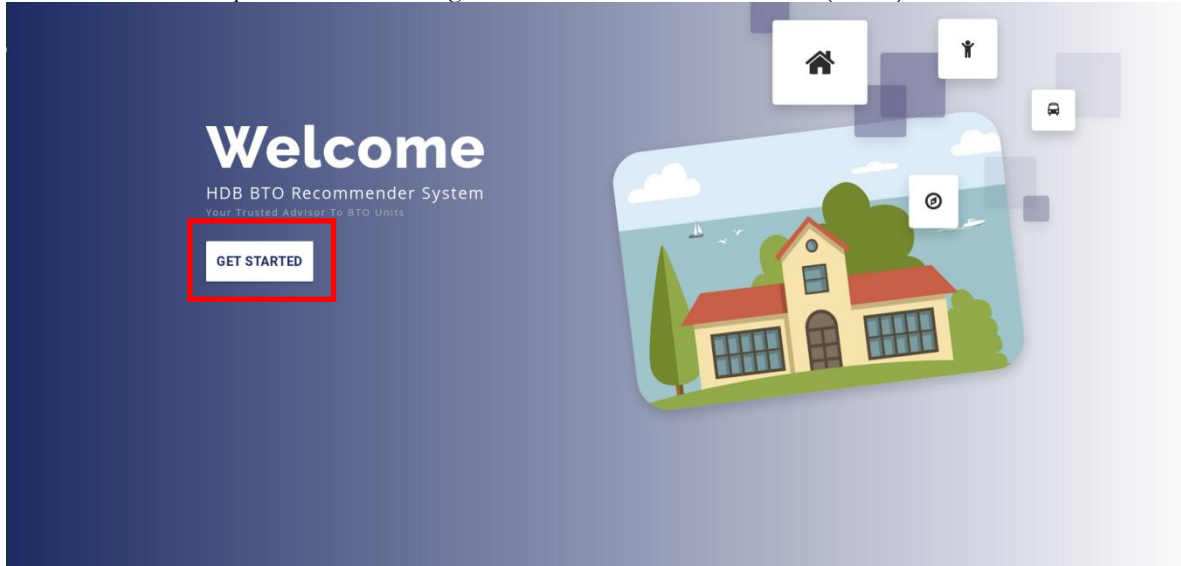
- cd <path of the system>/bto-recommender-system/clips
- python app.py

**START**

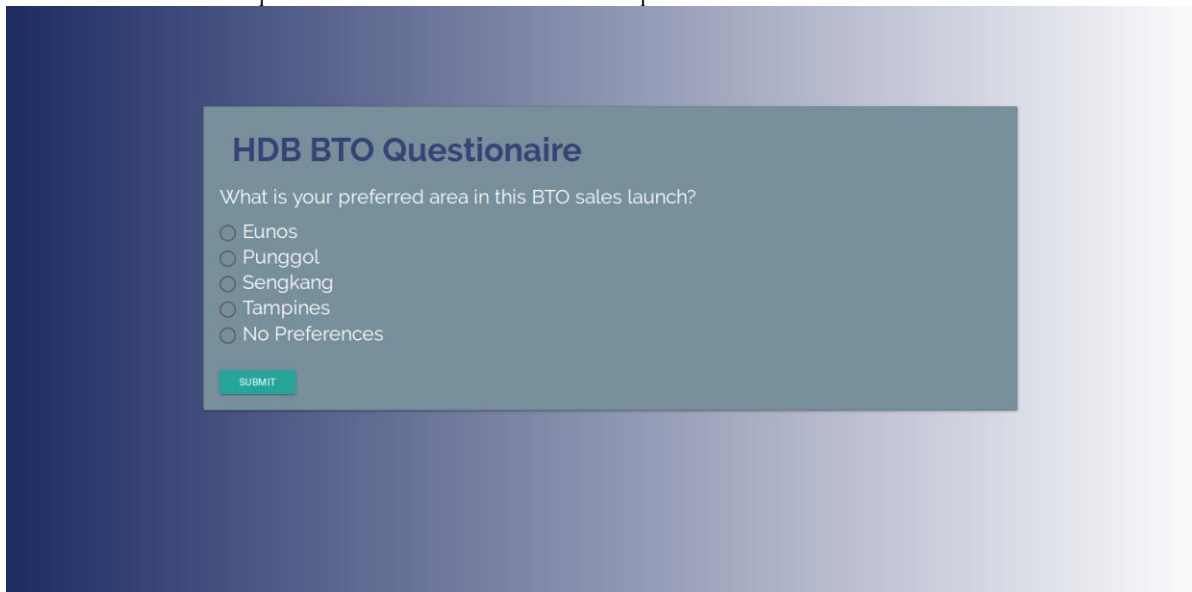
Open up your preferred browser and go to the URL “http://13.229.180.170:5000/bto/units” as shown below:



For the above example, we will be using Mozilla Firefox Version 58.0.2 (64-bit).



Click on the GET STARTED button. This will lead to the questionnaire session where users would select their choices based on the questions asked. Below is an example:



To proceed onto the next question, users are required to select one of the given options. If no input is selected, a prompt will appear to tell the user to select one of the options shown below:

## HDB BTO Questionnaire

What is your preferred area in this BTO sales launch?

☐ Sengkang

☐ Tampines

☐ No Preferences

☐ Sengkang

**! Please select one of these options.**

**SUBMIT**

The user will answer approximately 12 questions. After all the questions have been asked, our system will gather all the facts. Using our inference engine, the system will then output the top 3 BTO-units that best fit the user's description and requirement. Below shows one such example of the output:

## HDB BTO Questionnaire

**Our recommendations:**  
We recommend you a high level 3-Gen flat facing East/West near an MRT and a school.  
Here are the closest available units that fit your budget of \$775,000

Level	Unit	Block	Address	Project	Price	Level Type	Room Type	Location	Direction
FERNVALE GLADES	SENGKANG WEST WAY	460C	14	71	\$408,000	3-Gen	N-S	119 Sqm	30-Apr-21
FERNVALE GLADES	SENGKANG WEST WAY	460C	14	73	\$408,000	3-Gen	N-S	119 Sqm	30-Apr-21
FERNVALE GLADES	SENGKANG WEST WAY	461C	14	139	\$408,000	3-Gen	S-W	119 Sqm	30-Jun-21

The bottom portion of the page shows the listed price of the units that are on neighbouring floors of the one recommended by the system. Green indicate that the room is available to purchase, while red would mean the unit has already brought by someone else.

Alternatives which may interest you (based on top result)  
3-Gen Units for Block 460C in Project FERNVALE GLADES:  
Available Booked

Level / Unit	71	73
14	\$408,000	\$408,000
13	\$404,750	\$404,750
12	\$401,500	\$401,500
11	\$398,250	\$398,250
10	\$395,000	\$395,000
9	\$391,750	\$391,750
8	\$388,500	\$388,500
7	\$385,250	\$385,250
6	\$382,000	\$382,000
5	\$378,750	\$378,750
4	\$375,500	\$375,500
3	\$372,250	\$372,250
2	\$369,000	\$369,000

TRY AGAIN

As there will be cases whereby the best recommended unit is not available, for example if the particular unit is already booked or the particular project does not have such a room type, our system will then output the next best alternatives. One such case is shown below:

## HDB BTO Questionnaire

**Our recommendations:**  
We recommend you a high level 3-Gen flat facing East/West near an MRT.  
Here are the closest available units that in your budget of \$815,000

Level	Unit	Block	Address	Project	Price	Level Type	Room Type	Location	Direction
EUNOS COURT	EUNOS RD 2	37A	19	390	\$591,000	4-room	E-W	93 Sqm	30-Jun-22
EUNOS COURT	EUNOS RD 2	37A	18	390	\$586,941	4-room	E-W	93 Sqm	30-Jun-22
EUNOS COURT	EUNOS RD 2	37A	17	390	\$582,882	4-room	E-W	93 Sqm	30-Jun-22

To restart the questionnaire, simply scroll all the way down and click on the TRY AGAIN button as shown below:

3	\$181,083	\$181,083
2	\$178,000	\$178,000

TRY AGAIN

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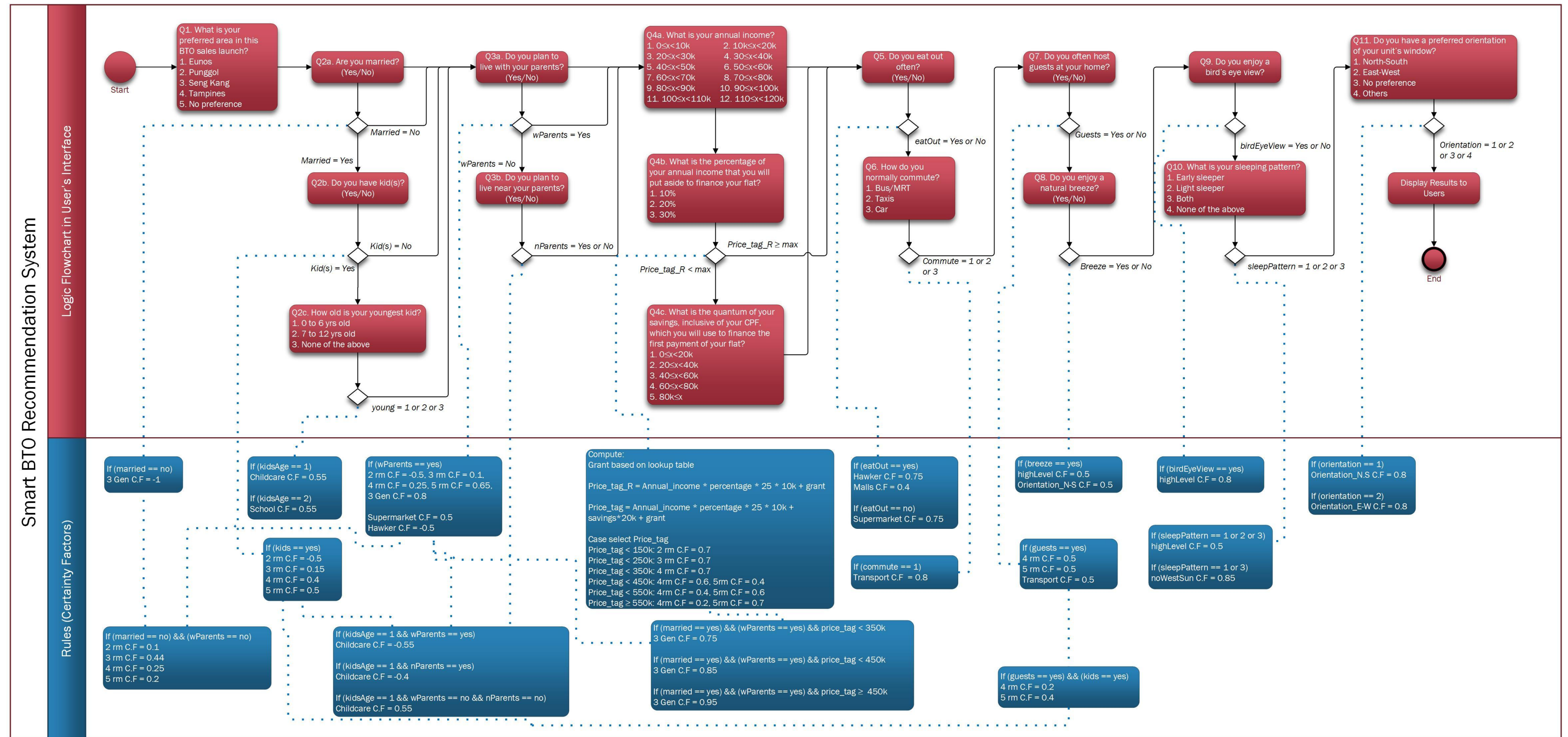
## **BUSINESS SCENARIOS: SAMPLE INPUT & SYSTEM OUTPUT**

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In this section, the objective is to demonstrate the intelligence and robustness of the HDB BTO Recommender system. Considering rational needs of various potential home owners, three business test cases are developed and executed in the system so as to examine the output. Explained in section 3.2, certainty factors (C.F) to identify users' preference on specific features are built into the system. Every input from the users has an impact on the certainty factors which eventually influences the output. An outline of the system flow as well as the association with certainty factors is presented in Figure 6 below. The red section covers questions which users have to answer while the blue section associates the inputs from the questions to the certainty factors.



# Smart BTO Recommendation System: Business Process Model & Data Flow



## Legend:



User's input



UI Output/Qns



Rules on Certainty Factors

→ System Flow


..... Association

Figure 6: Outline of System Flow




## 2.1 SCENARIO 1

Characteristic of user (Standard Case)	36 year old Unmarried individual (One-Person Household) employed in the Account industry with a monthly income of \$8,200 and not intending to stay near the parents. He has a passion for cooking.																																						
Questions:	<div>1. What is your preferred are in this BTO sales launch? : Eunost</div> <div>2. Are you married ? : No</div> <div>3. Do you plan to live with your parents ? : No</div> <div>4. Do you plan to live near your parents ? : No</div> <div>5. What is your average monthly household income ? : \$8,200</div> <div>6. What is the percentage of your annual income that you will put aside to finance your flat ? : 20%</div> <div>7. What is the quantum of your savings, inclusive of your CPF, which you will use to finance the first payment of your flat?: Between \$40,000 and \$60,000</div> <div>8. Do you eat out often ? : No</div> <div>9. How do you normally commute ? : Bus / MRT</div> <div>10. Do you often host guests at your home ? : Yes</div> <div>11. Do you enjoy a natural breeze ? : Yes</div> <div>12. Do you enjoy a bird’s eye view ? : Yes</div> <div>13. What is your sleeping pattern ? : Early sleeper</div> <div>14. Do you have a preferred orientation of your unit’s windows? : E-W</div>																																						
System output (sample)	<div><div>Our recommendations:</div><div>We recommend you a high level 5-room flat facing East/West near an MRT and a supermarket. Here are the closest available units that fit your budget of \$580,000</div><table><thead><tr><th>Project</th><th>Address</th><th>Block</th><th>Level</th><th>Unit</th><th>Price</th><th>Room Type</th><th>Direction</th><th>Floor Area</th></tr></thead><tbody><tr><td><div><div></div><div>EUNOS COURT</div></div></td><td>EUNOS RD 2</td><td>37A</td><td>16</td><td>390</td><td>\$578,824</td><td>4-room</td><td>E-W</td><td>93 Sqm</td></tr><tr><td><div><div></div><div>EUNOS COURT</div></div></td><td>EUNOS RD 2</td><td>37A</td><td>15</td><td>390</td><td>\$574,765</td><td>4-room</td><td>E-W</td><td>93 Sqm</td></tr><tr><td><div><div></div><div>EUNOS COURT</div></div></td><td>EUNOS RD 2</td><td>37A</td><td>14</td><td>390</td><td>\$570,706</td><td>4-room</td><td>E-W</td><td>93 Sqm</td></tr></tbody></table></div>			Project	Address	Block	Level	Unit	Price	Room Type	Direction	Floor Area	<div><div></div><div>EUNOS COURT</div></div>	EUNOS RD 2	37A	16	390	\$578,824	4-room	E-W	93 Sqm	<div><div></div><div>EUNOS COURT</div></div>	EUNOS RD 2	37A	15	390	\$574,765	4-room	E-W	93 Sqm	<div><div></div><div>EUNOS COURT</div></div>	EUNOS RD 2	37A	14	390	\$570,706	4-room	E-W	93 Sqm
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Analysis of system output	Features	Output	Explanation of system’s output																																				
	Project	Eunos	This option was explicitly chosen by the user																																				
	Room size	5-Room	Based on user’s input, the system has recommended a 5-room flat. However, since eunos project only has 2,3,4 room flats, the system has displayed 4-room flats as the next closest option																																				

Block	37 A	<p>There are 6 blocks available in the Eunos project. Of the 6, the system has displayed block 37A due to its proximity to MRT (As expressed by the user while answering the questionnaire)</p> <p>With reference to the image on the right, it can be seen that 37A is the block that is closest to a supermarket and the MRT station</p> 
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## 2.2 SCENARIO 2

Characteristic of user (Challenging)	Newly married couple with a monthly household income of \$7,500 intending to live near their parents.
Questions:	<ol style="list-style-type: none"> <li>1. What is your preferred are in this BTO sales launch? : No preference</li> <li>2. Are you married ? : Yes</li> <li>3. Do you have kid(s) ? : Yes</li> <li>4. How old is your youngest kid ? : 0-6 years old</li> <li>5. Do you plan to live with your parents ? : No</li> <li>6. Do you plan to live near your parents ? : No</li> <li>7. What is your average monthly household income ? : \$7,500</li> <li>8. What is the percentage of your annual income that you will put aside to finance your flat ? : 20%</li> <li>9. What is the quantum of your savings, inclusive of your CPF, which you will use to finance the first payment of your flat?: Between \$20,000 and \$40,000</li> <li>10. Do you eat out often ? : Yes</li> <li>11. How do you normally commute ? : Car</li> <li>12. Do you often host guests at your home ? : No</li> <li>13. Do you enjoy a natural breeze ? : Yes</li> <li>14. Do you enjoy a bird's eye view ? : Yes</li> <li>15. What is your sleeping pattern ? : Early and Light sleeper</li> <li>16. Do you have a preferred orientation of your unit's windows? : No Preference</li> </ol>

System output (sample)	<div><p><b>Our recommendations:</b></p><p>We recommend you a high level 5-room flat facing North/South near childcare facilities and a hawker centre. Here are the closest available units that fit your budget of \$510,000</p></div> <table><thead><tr><th>Project</th><th>Address</th><th>Block</th><th>Level</th><th>Unit</th><th>Price</th><th>Room Type</th><th>Direction</th></tr></thead><tbody><tr><td>+ FERNVALE GLADES</td><td>SENGKANG WEST WAY</td><td>460A</td><td>14</td><td>77</td><td>\$402,000</td><td>5-room</td><td>N-S</td></tr><tr><td>+ FERNVALE GLADES</td><td>SENGKANG WEST WAY</td><td>460B</td><td>14</td><td>103</td><td>\$402,000</td><td>5-room</td><td>N-S</td></tr><tr><td>+ FERNVALE GLADES</td><td>SENGKANG WEST WAY</td><td>461B</td><td>14</td><td>133</td><td>\$402,000</td><td>5-room</td><td>N-S</td></tr></tbody></table>			Project	Address	Block	Level	Unit	Price	Room Type	Direction	+ FERNVALE GLADES	SENGKANG WEST WAY	460A	14	77	\$402,000	5-room	N-S	+ FERNVALE GLADES	SENGKANG WEST WAY	460B	14	103	\$402,000	5-room	N-S	+ FERNVALE GLADES	SENGKANG WEST WAY	461B	14	133	\$402,000	5-room	N-S
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Analysis of system output	Features	Output	Explanation of system's output																																
	Project	To specify	The system does not recommend him the project at Eunus unlike the first test case. This is because the user drives and need not stay near a MRT. Staying outside Eunus also give him greater options in terms of room size.																																
	Room size	5 Room	The system has recommend a 5 room flat because the home owner(s) are able to afford it. They earn a reasonably high income and has substantial savings for the down-payment. In addition, they have a kid and therefore has a higher tendency to demand for larger room size.																																
	Amenities/ Project	Child Care centre	<div><p>The system recommends the user a flat near to a childcare centre. This is because the family has a young kid (0 to 6 years old) and do not stay near/with their parents. Hence, it is likely that the family lacks a caretaker for their kid and would require the service of a childcare center.</p><p>With reference to the image on the right, it can be seen that Block 460A and 460B is nearer to the child care as compared to the other blocks. Also, Block 461B has been listed by the system even though its relatively further from the child care because 5-room units are not available in the other blocks.</p></div> <div></div>																																

### 2.3 SCENARIO 3

Scenario (3) (Standard Case)	A family of five (3G Household) with a total monthly income of \$6,000 applying BTO for the first time.																																		
Questions:	<div><div>1. What is your preferred are in this BTO sales launch? : Sengkang</div><div>2. Are you married ? : Yes</div><div>3. Do you have kids ? : Yes</div><div>4. How old is your youngest kid ? : 0-6 years old</div><div>5. Do you plan to live with your parents ? : Yes</div><div>6. What is your average monthly household income ? : \$6,000</div><div>7. What is the percentage of your annual income that you will put aside to finance your flat ? : 20%</div><div>8. What is the quantum of your savings, inclusive of your CPF, which you will use to finance the first payment of your flat?: Between \$20,000 to \$40,000</div><div>9. Do you eat out often ? : No</div><div>10. How do you normally commute ? : Bus</div><div>11. Do you often host guests at your home ? : No</div><div>12. Do you enjoy a natural breeze ? : No</div><div>13. Do you enjoy a bird's eye view ? : No</div><div>14. What is your sleeping pattern ? : Early</div><div>15. Do you have a preferred orientation of your unit's windows? : No Preference</div></div>																																		
Analysis of system output	<div><div><div>Our recommendations:</div><div>We recommend you a medium level 3-Gen flat near a supermarket and an MRT.</div><div>Here are the closest available units that fit your budget of \$435,000</div></div><table><thead><tr><th>Project</th><th>Address</th><th>Block</th><th>Level</th><th>Unit</th><th>Price</th><th>Room Type</th><th>Direction</th></tr></thead><tbody><tr><td><div><div></div><div>FERNVALE GLADES</div></div></td><td>SENGKANG WEST WAY</td><td>460C</td><td>12</td><td>73</td><td>\$401,500</td><td>3-Gen</td><td>N-S</td></tr><tr><td><div><div></div><div>FERNVALE GLADES</div></div></td><td>SENGKANG WEST WAY</td><td>460C</td><td>10</td><td>71</td><td>\$395,000</td><td>3-Gen</td><td>N-S</td></tr><tr><td><div><div></div><div>FERNVALE GLADES</div></div></td><td>SENGKANG WEST WAY</td><td>460C</td><td>10</td><td>73</td><td>\$395,000</td><td>3-Gen</td><td>N-S</td></tr></tbody></table></div>			Project	Address	Block	Level	Unit	Price	Room Type	Direction	<div><div></div><div>FERNVALE GLADES</div></div>	SENGKANG WEST WAY	460C	12	73	\$401,500	3-Gen	N-S	<div><div></div><div>FERNVALE GLADES</div></div>	SENGKANG WEST WAY	460C	10	71	\$395,000	3-Gen	N-S	<div><div></div><div>FERNVALE GLADES</div></div>	SENGKANG WEST WAY	460C	10	73	\$395,000	3-Gen	N-S
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Analysis of system output	Features	Output	Explanation of system's output																																
	Level	Medium	The system has recommended a medium level flat because the user is not particularly fond of natural breeze or a bird's eye view. In addition, based on the stated Income and family size, the user will only be able to afford a Medium level 3-Gen flat.																																
	Room-Type	3-Gen	The system has recommended a 3-Gen flat because the user has a family of at least 5 members (Based on the input provided)																																