



UNIVERSITY OF NEW SOUTH WALES

COMP3900

Project Report: *localhost*

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1 Introduction

1.1 Motivations

“Sydney has 600,000 bedrooms not being used according to data compiled by EY from 2016 Census estimates.”

Michael Cranston, Australian Financial Review

The need for an alternative to hotels for short-term property rentals as well as the abundance of spare rooms in homes has led to the innovation of a number of new platforms such as Airbnb and Stayz. These platforms provide hosts with a marketplace to rent their properties of rooms and provide guests with affordable short-term accommodation. One of the major downsides with Airbnb-like platforms, is that the price for the property or room is static and does not change regardless of demand or lack thereof. If the price of a listing is too high on a particular night but would have been purchased by a guest if it was slightly cheaper, the listing would remain vacant. This is a loss for both the host and the prospective guest. A better pricing model is required, one that is regulated by the supply and demand such that both owners and tenants may benefit financially.

1.2 Aim

The aim of the project was to design and implement a fast-paced auction platform for single night stays. Compared to the static pricing model of existing platforms, the dynamic nature of the auction system optimises the occupancy rate and profitability of properties. The price of each property item is determined by market supply and demand, greatly improving profitability for hosts and allowing guests to find cheap accommodation on properties with low demand.

Figure 1.2.1 shows theoretical earnings over the course of a week for a traditional fixed-price platform and our *localhost* platform. Earnings are lower on the traditional platform as the price is deemed too steep on days of low demand and the property is left empty. By contrast, the *localhost* allows income for hosts even on days of low demand, albeit at a low rate. On days with high demand, the price paid may exceed the price that would have been statically set on traditional platforms. Guests also benefit from this model as they can find bargains on days of low demand.

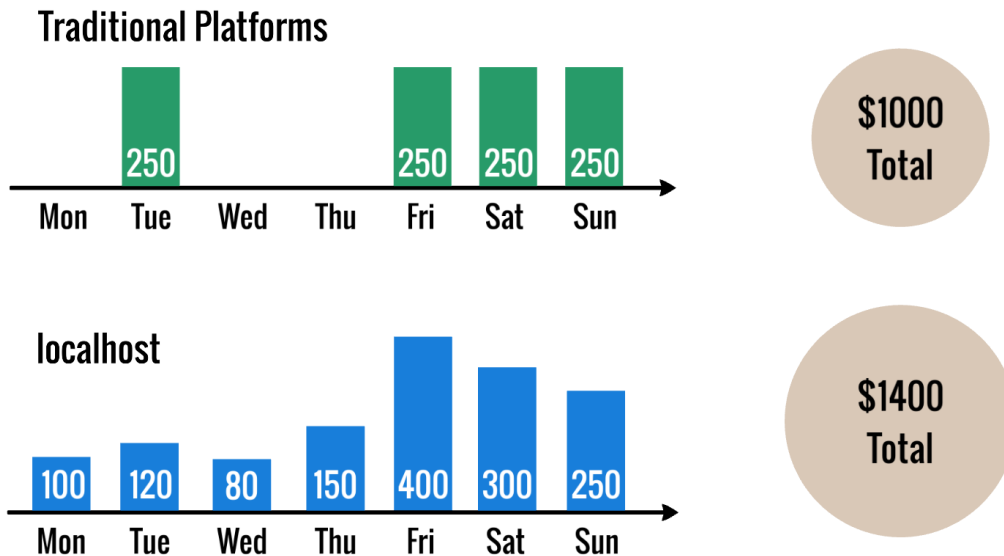


Figure 1.2.1: Theoretical comparison of Fixed-Pricing vs Auctions

1.3 Concepts

1.3.1 Auction Sessions

Session	Start Time	End Time
1	12pm	6pm
2	6pm	8pm
3	8pm	10pm
4	10pm	12am
5	12am	3am

Table 1.3.1: Auction Session Times

Auctions on our platform run in fixed sessions ranging in time from two to six hours. At the end of every session the highest bidder wins the auction and a booking is made. As seen in Table 1.3.1, auction sessions start running from midday to 3am the following day, with shorter sessions for stages of the day where a higher volume of bids are expected and longer sessions for periods of low volume such as early afternoon.

The purpose of having multiple sessions is to give prospective guests multiple chances to win a bid throughout the day. If the guest loses a bid earlier in the day, he has additional chances later that night to win another bid. If auction sessions were not enforced and owners could choose their own session times, they would choose a single long session throughout the day which

would maximise the number of bids to optimise their profits. Instead, hosts must decide which sessions their properties are listed for auction based on personal factors such as latest guest check-in time.

1.3.2 Buyout Option

A buyout option exists for guests to immediately purchase the item without having to wait for the auction session to end. Guests may choose to trade off cost for convenience and hosts receive large financial benefit from buyouts. Buyouts will immediately end the auction session and award the property item to the buyer.

2 Dependencies

This project uses the following dependencies.

2.1 Celery

When an auction session comes to an end, the system needs to check if there are any bids under property item. If there are, the system should clean up all the bids associated with the property item and adds a booking to the winner's account. *localhost* solves this by using a plug-in called Celery. It provides a distributed task queue which delays the execution of certain jobs to a particular time “Celery Project Documentation”, 2018. In our use case, we set up periodic tasks for each property item so that it execute certain tasks when auction session is closed.

2.2 channels-redis

channels-redis is a Django Channels channel layer that uses Redis as its backing store “channels-redis”, 2018. This allows Django Channels to “communicate” across different ASGI instances, which is useful if we were to scale the website to run on a distributed system.

2.3 daphne

Daphne is a HTTP, HTTP2 and WebSocket protocol server for ASGI and ASGI-HTTP that was designed for Django Channels “Daphne”, 2018. It mainly handles WebSocket requests in our website, for example, bid requests, messaging and push notifications.

2.4 Django

The main framework this project runs on is Django. It is a high-level Python Web framework that allows the team to quickly prototype a working product with clean and pragmatic design. It is extremely scalable since it supports adding “apps” to a working site to extend its functionality “Django”, 2018.

2.5 Django Channels

Django Channels extends Django's ability beyond HTTP to handle WebSocket requests, chat protocols, etc. It allows communications between client and server using a long-running connection, while at the same time preserve

Django’s synchronous and easy-to-use nature “Django Channels Documentation”, 2018. All of the real-time components of the project are implemented within the Django Channels framework, including auctions, messaging and push notifications.

2.6 **django-celery-beat**

This extension allows us to store Celery `PeriodicTask` in the database, which could then be modified during runtime “Django Celery Beat Documentation”, 2018. This is useful since we might have to change tasks execution interval if auction sessions are modified for a property item during run-time.

2.7 **django-widget-tweaks**

Widget-tweaks allows us to inject CSS attributes into form fields in templates “Django Widget Tweaks”, 2018. This means we can separate the business logic in “views”¹ and “templates”. For example, if we want to add `class="form-control"` into a form input without widget-tweaks, we would need to append the class names in `__init__()` in the form class. With widget-tweaks, we can change the field representation in templates with Django template syntaxes (liquid tags).

2.8 **Factory Boy**

To generate our test data for both unit-tests and performance benchmark, we use Factory Boy to create random but reasonable test data. We use an extension instead of creating fixtures on our own so that it is easier to maintain and the data is reproducible and consistent “Factory Boy”, 2018.

2.9 **googlemaps**

This is a Python Client for Google Maps Services which creates an abstraction between the Google Maps raw JSON API and our Django application “Python Client for Google Maps”, 2018. We use this library to access the Maps API in backend.

2.10 **gunicorn**

Gunicorn is a Python WSGI HTTP Server for UNIX “Gunicorn”, 2018.

¹Django view functions or Django class-based views

2.11 psycopg2-binary

psycopg2 is a binder/adaptor between Python and PostgreSQL. It allows any Python application to connect to a PostgreSQL database instance “Psycopg2”, 2018.

2.12 redis (Python)

redis is a Python client for Redis “Python Redis”, 2018.

3 Licensing

Below is a list of license used by all the dependencies.

Dependency	Version	License
Automat	0.7.0	MIT
Django	2.1.2	BSD
Faker	0.9.1	MIT
Pillow	5.3.0	PIL
PyHamcrest	1.9.0	BSD
Twisted	18.7.0	MIT
aioredis	1.1.0	MIT
amqp	2.3.2	BSD
asgiref	2.3.2	BSD
async-timeout	3.0.0	Apache
attrs	18.2.0	MIT
autobahn	18.9.2	MIT
billiard	3.5.0.4	BSD
celery	4.1.1	BSD
certifi	2018.8.24	MPL-2.0
channels	2.1.3	BSD
channels-redis	2.3.0	BSD
chardet	3.0.4	LGPL
constantly	15.1.0	MIT
daphne	2.2.2	BSD
django-celery-beat	1.1.0	BSD
django-widget-tweaks	1.4.3	MIT
ephem	3.7.6.0	LGPL
factory-boy	2.11.1	MIT
googlemaps	3.0.2	Apache
gunicorn	19.9.0	MIT

hiredis	0.2.0	BSD
hyperlink	18.0.0	MIT
idna	2.7	BSD-like
incremental	17.5.0	MIT
kombu	4.2.1	BSD
msgpack	0.5.6	Apache
psycpg2-binary	2.7.5	LGPL
python-dateutil	2.7.3	Dual
pytz	2018.5	MIT
redis	2.10.6	MIT
requests	2.19.1	Apache
six	1.11.0	MIT
text-unidecode	1.2	Artistic
txaio	18.8.1	MIT
urllib3	1.23	MIT
vine	1.1.4	BSD
zope.interface	4.5.0	ZPL

4 Implementation

4.1 Architecture

4.2 User Interface

4.3 Database Design

4.4 Real Time Communication

4.5 Event Scheduling

When an auction session ends, tasks need to be performed in order to complete the bidding process. There are also several places where scheduled/delayed tasks are needed in the application.

Property items are said to be “available” if the *available* option is turned on by user (it is “on” by default when created) and there are no bids in all the previous auction sessions in the same day. When the local time reaches the end time of the session, the system have to check whether there are bids in the session and create a booking for the winner. Property items that has been booked out has to be marked as “unavailable” so that it does not come up in the search results. Furthermore, property item has to be re-listed (marked as “available”) at 12 noon every day.

4.5.1 Django Signals

Signals are dispatched in Django when a certain action is performed within the framework. It helps decoupled applications to get notified when the actions are taken placed “Django Signals Documentation”, 2018. Django provides a set of built-in signals that allows us to combine it with Celery to perform certain tasks when signals are dispatched. A list of signals we used in the project are:

- `django.db.models.signals.m2m_changed`
- `django.db.models.signals.pre_save`

4.5.2 Celery Beat

Celery beat is a scheduler in Celery that kicks off tasks at regular intervals, that are then executed by available worker nodes in the cluster “Celery Beat Documentation”, 2018. The worker works asynchronously to start task execution and store results in a Redis instance.

By default, beat uses `PersistentScheduler` that keeps track of the last run in a local shelve² database file. But that is not necessary since we already have a PostgreSQL database active in the backend. So we instead use an extension `django-celery-beat` 2.6 that allows us to store tasks in the Django database through a `DatabaseScheduler`. The extension also provides an admin interface so that tasks could be managed by the administrator.

Periodic Task `PeriodicTask` is a Django model provided by `django-celery-beat` 2.6 that simulates how Celery tasks are represented in the database. We use this in conjunction with `DatabaseScheduler` to provide background services in the Django framework.

4.5.3 Combining both signals and Celery beat

There are two tasks to be completed in the background:

1. check if anyone bid on a property item; if there is, a booking is added to the winner's account, and bids associated with the property item are removed. Property item is marked as "unavailable" as well. Otherwise we do nothing about that property item.
2. enable bidding for all property items at 12 noon

As such, we define two tasks in Celery accordingly: `cleanup_bids` and `enable_bids`. Whenever an auction session is added to a property item (`m2m_changed`), we add a `PeriodicTask` to the database that executes `cleanup_bids`. A `PeriodicTask` that executes `enable_bids` is added when a property item is saved (`pre_save`). When celery is launched, the scheduler will pick up the tasks and triggers tasks execution when time reaches.

²a persistent, dictionary-like object

5 Deployment

localhost is deployed using Amazon Web Services on an Amazon Elastic Compute Cloud instance with the following specifications.

OS: Ubuntu 18.04.1 LTS x86_64
Host: HVM domU 4.2.amazon
Kernel: 4.15.0-1023-aws
CPU: Intel Xeon E5-2676 v3 (1) @ 2.4
GPU: Cirrus Logic GD 5446
Memory: 983MiB

5.1 Amazon Web Services Configuration

After creating an Amazon Elastic Compute Cloud instance through the Amazon Web Services dashboard, the only port on the server accessible from the internet is 22 (SSH). For the server to accept web requests, ports 80 (HTTP) and 443 (SSL) must be opened. This can be done by navigating to the dashboard, selecting the running *Amazon Elastic Compute Cloud* instance, and selecting `launch-wizard`. A tab will then appear at the bottom of the page and will contain a form that can open ports.

5.2 Software

While a number of scripts are provided to automate the installation and configuration of *localhost*, some manual configuration is required. The configuration required varies between different Linux distribution so the following steps are only supported on Ubuntu 18.04.1.

The default user account provided on an Amazon Elastic Compute Cloud instance running Ubuntu 18.04.1 is `ubuntu` and the following commands rely on this assumption. Commands requiring sudo privileges are prepended with `#` and commands executed under user permissions are prepended with `$`.

5.2.1 Update

The initial state of the instance is likely out of date and should be brought up to date by running the following command.

```
# apt update && apt upgrade && apt dist-upgrade && apt autoremove
```

5.2.2 Repository

To ease updating, an SSH key will be generated to authenticate the server when accessing the repository.

```
$ ssh-keygen -t rsa -b 4096
Enter file in which to save the key (/home/ubuntu/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in id_rsa.
Your public key has been saved in id_rsa.pub.
```

After adding `/home/ubuntu/.ssh/id_rsa.pub` to BitBucket the repository can be cloned.

```
$ git clone git@bitbucket.org:jtalowell/localhost.git
/home/ubuntu/localhost
```

5.2.3 Django & Immediate Dependencies

To install a virtual environment and manage dependencies the following packages must be installed.

```
# apt install python3-venv python3-pip
```

Django and its immediate dependencies can then be installed.

```
$ cd /home/ubuntu/localhost
$ python3 -m venv venv
$ source venv/bin/activate
$ (venv) pip install -r requirements.txt
```

5.2.4 PostgreSQL

PostgreSQL must be installed and it's accompanying system service enabled.

```
# apt install postgresql postgresql-contrib
# systemctl enable postgresql.service
# systemctl start postgresql.service
```

The database cluster can then be created.

```
$ sudo -u postgres -i
[postgres]$ /usr/lib/postgresql/10/bin/initdb -D
'/var/lib/postgresql/data'
```

A user to administer the database clustered must be created for access.

```
[postgres]$ createuser --interactive
Enter name of role to add: ubuntu
Shall the new role be a superuser? (y/n) y
[postgres]$ exit
```

The database to use for the project can now be created.

```
$ createdb localhost_db
$ sudo -u postgres -i
[postgres]$ psql
postgres=# \password ubuntu
Enter new password: [DB_PW]
Enter it again: [DB_PW]
postgres=# GRANT ALL PRIVILEGES ON DATABASE localhost_db TO ubuntu;
postgres=# ALTER ROLE ubuntu SET client_encoding TO 'utf8';
postgres=# ALTER ROLE ubuntu SET default_transaction_isolation TO
    'read committed';
postgres=# \q
[postgres]$ exit
```

5.2.5 Redis

Ubuntu's package for Redis works without any extended configuration and its services are automatically started and enabled.

```
# apt install redis-server
```

5.2.6 Daphne

Daphne is installed as one of Django's immediate dependencies. A service script is provided for installation.

```
# ln -sf /home/ubuntu/localhost/deploy/systemd/daphne.service
    /etc/systemd/system/
# vim /etc/systemd/system/daphne.service
```

The environment variables for SECRET_KEY, DB_USER, and DB_PW must be set for Daphne to be able to operate. This can be done by inserting the following lines in the service script.

```
Environment="SECRET_KEY=YOUR KEY HERE"
Environment="DB_USER=ubuntu"
```

```
Environment="DB_PW=YOUR DB PASSWORD HERE"
```

5.2.7 Gunicorn

Gunicorn, like Daphne, is installed as one of Django's immediate dependencies. A service script is provided for installation.

```
# ln -sf /home/ubuntu/localhost/deploy/systemd/gunicorn.service
    /etc/systemd/system/
# vim /etc/systemd/system/gunicorn.service
```

The environment variables for SECRET_KEY, DB_USER, and DB_PW must be set for Gunicorn to be able to operate. This can be done by inserting the following lines in the service script.

```
Environment="SECRET_KEY=YOUR KEY HERE"
Environment="DB_USER=ubuntu"
Environment="DB_PW=YOUR DB PASSWORD HERE"
```

5.2.8 NGINX

NGINX can be installed using the following commands.

```
# apt install nginx
# systemctl enable nginx
# systemctl start nginx
```

The relevant configuration files can be installed by:

```
# /home/ubuntu/localhost/deploy/init.sh [SECRET_KEY] [DB_USER]
    [DB_PW]
```

localhost uses Let's Encrypt as the provider for its SSL certificates. The certificates can be installed using the Certbot tool which can be installed and executed by the following commands. For this to work, the domain name registered for *localhost* should direct to the IP address of the Amazon Elastic Compute Cloud instance.

```
# apt install software-properties-common
# add-apt-repository ppa:certbot/certbot
# apt update
# apt install python-certbot-nginx
# certbot --nginx certonly
```


After installing the certificate the `init.sh` script should be executed again.

```
# /home/ubuntu/localhost/deploy/init.sh [SECRET_KEY] [DB_USER]
[DB_PW]
```

This script first ensures that the NGINX configuration script is installed and restarts all the services that *localhost* depends on.

5.2.9 Maintenance

There are two scripts that are provided to ease server upgrades and deployment testing. The first script is `rebuild.sh`. This script automates the dropping, creation, migrations, and loading of test data for the database. This is useful for quickly loading a usable set of test data without manually creating listings and accounts. It's also extendable to restore backups.

```
$ ./rebuild.sh [database name] -Mmsl [data name]
-M is short for --Makemigrations
-m is short for --migrate
-s is short for --server and should only be used on the server
  deployment
-l is short for --loaddata and loads both testdata and
  propertyimages
```

The second script has already been mentioned but remains relevant for future updates. `init.sh` should be ran every time any updates or upgrades take place to restart the required services otherwise unexpected errors can occur through caching.

```
# ./init.sh [SECRET_KEY] [DB_USER] [DB_PW]
```

6 Manual

References

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A User Tests

A.1 Andy

Version 0.1.0 - 06 Oct, 2018

Supervisor: Edward

Tester: Andy

Completion Date: 06 Oct

Completion Time (24HR):

Instruction Set

1. **Create a user account and login**

User difficulty rating (Out of 5): 3

Supervisor comments:

Too many security requirements for password

Should be a pop-up or modal to prompt user that account has been created. Any confirmation.

Recommends that dob and gender should not be required for signup, but part of profile creation

that user can do later. Lower barrier of entry

2. **Add \$150 to your wallet**

User difficulty rating (Out of 5): 4 for navigation

Supervisor comments:

Tabs are faint on dashboard, hard for people with poor eyesight to see

Confirmed for recharge success

3. **Search for a listing in kingsford**

User difficulty rating (Out of 5): 3, could be higher if navigation was clearer

Supervisor comments:

Needs a clearer home button on dashboard

The search bar was not distinguishable

Since enter button doesn't work, instead of saying "Try

Kingsford", tell them to select Kingsford or something

4. **Submit a bid on first listing in first property in search results**

User difficulty rating (Out of 5): 3

Supervisor comments:

Confirmation that bid was succesful

Listing requires more information

An actual web-page back button, rather than just the browser back
Should be clearer that you're the current top bidder
More description needed for the rooms, detail lacking

5. ****Find the list of user's currently active bids****

User difficulty rating (Out of 5): 4

Supervisor comments:

Activity tab name is bit vague

Countdown timer for how long until auction ends

Needs more information: property name, address

Maybe potential to re-bid on activity page

6. ****Navigate to the listing that was previously bid on without
searching the location****

user difficulty rating (out of 5): 1

supervisor comments:

Easy to navigate, but activity page was lacking description

Refer to comments in 5

7. ****Message owner of the listing previously bid on****

user difficulty rating (out of 5): 1

supervisor comments:

Button to directly message host, instead of going to host profile

Message should refer to the property that was in question

8. ****Create a listing****

User difficulty rating (Out of 5): 2

Supervisor comments:

Amenities list is slightly unintuitive. Bubbles?

Headings need to be reworded. New Item needs to be renamed

9. ****Navigate to the home page****

User difficulty rating (Out of 5): 2

Supervisor comments:

10. ****Find the listing that was created without searching the
location****

User difficulty rating (Out of 5): 4

Supervisor comments:

11. ****Edit user profile****

user difficulty rating (out of 5): 2

supervisor comments:

Unclear what you are editing

12. ****View user profile****

user difficulty rating (out of 5): 4

supervisor comments:

Overall Thoughts

Supervisor comments:

User comments:

First glance, the home page is unclear what the purpose of the site is

A.2 Anish

Version 0.1.0 - 06 Oct, 2018

Supervisor: Ed

Tester: Anish

Completion Date: 6 Oct

Completion Time (24HR):

Instruction Set

1. ****Create a user account and login****

User difficulty rating (Out of 5): 3

Supervisor comments:

Password confirmation unclear, impressed by password security

2. ****Add \$150 to your wallet****

User difficulty rating (Out of 5): 3

Supervisor comments:

Overflow when he tried to add 1000000000000

3. ****Search for a listing in Kensington****

User difficulty rating (Out of 5): 2

Supervisor comments:

From dashboard, hard to get to search.

Search bar wasn't clear enough

4. ****Submit a bid on first listing in first property in search results****

User difficulty rating (Out of 5): 3

Supervisor comments:

Doesn't show user has winning bid
Should have link to wallet if not enough funds

5. ****Find the list of user's currently active bids****
User difficulty rating (Out of 5): 4
Supervisor comments:

6. ****Navigate to the listing that was previously bid on without searching the location****
user difficulty rating (out of 5): 5
supervisor comments:

7. ****Message owner of the listing previously bid on****
user difficulty rating (out of 5): 5
supervisor comments:

8. ****Create a listing****
User difficulty rating (Out of 5): 2
Supervisor comments:
Button was hard to find

9. ****Navigate to the home page****
User difficulty rating (Out of 5): 2
Supervisor comments:

10. ****Find the listing that was created without searching the location****
User difficulty rating (Out of 5): 5
Supervisor comments:

11. ****Edit user profile****
user difficulty rating (out of 5): 4
supervisor comments:

12. ****View user profile****
user difficulty rating (out of 5): 5
supervisor comments:

Overall Thoughts

Supervisor comments:

User comments:

overall pretty intuitive, however some of the buttons were pretty tricky to find, (e.g. home pages, adding property), and the

fonts could generally be bigger

A.3 Ming

```
##### Version 0.1.0 - 06 Oct, 2018
##### Supervisor: Edward
##### Tester: Ming
##### Completion Date: 6 Oct
##### Completion Time (24HR):

# Instruction Set
1. **Create a user account and login**
*User difficulty rating (Out of 5):* 3
*Supervisor comments*:
Wanted to register as 'other' gender
Maybe age restriction on dob

2. **Add $150 to your wallet**
*User difficulty rating (Out of 5):* 3
*Supervisor comments*:
Call dashboard 'account' or something more intuitive
Confirmation before and after money is added

3. **Search for a listing in kingsford**
*User difficulty rating (Out of 5):* 2
*Supervisor comments*:
Search bar was hard to see in background
Had to navigate to home before search

4. **Submit a bid on first listing in first property in search
   results**
*User difficulty rating (Out of 5):* 3
*Supervisor comments*:

5. **Find the list of user's currently active bids**
*User difficulty rating (Out of 5):* 1
*Supervisor comments*:
Looked inside booking history
Bids should be under a subcategory in Activity, or rename Activity

6. **Navigate to the listing that was previously bid on without
   searching the location**
```


user difficulty rating (out of 5): 4
supervisor comments:

7. **Message owner of the listing previously bid on**

user difficulty rating (out of 5): 2
supervisor comments:

Should be a button that can directly message, rather than go to
profile

Should link property/listing in question to the message

8. **Create a listing**

User difficulty rating (Out of 5): 2
Supervisor comments:

Button out of place

9. **Navigate to the home page**

User difficulty rating (Out of 5): 2
Supervisor comments:

Should be top left, on dashboard page

10. **Find the listing that was created without searching the
location**

User difficulty rating (Out of 5): 4
Supervisor comments:

11. **Edit user profile**

user difficulty rating (out of 5):
supervisor comments: 2

Form should be clearer, should say changing description.
Didn't know if he was changing dob, name, etc

12. **View user profile**

user difficulty rating (out of 5):
supervisor comments: 4

Overall Thoughts

Supervisor comments:
User comments: 2.5/5

Hard to navigate, things are still unpolished and unclear. Make
things more obvious

Eg. Home button should consistently be at top left, adding
property button, search bar is hard to see

More specific titles

A.4 Weilon

```
##### Version 0.1.0 - 06 Oct, 2018
##### Supervisor: Thomas Lam
##### Tester: Weilon Ying
##### Completion Date: 06-10-2018
##### Completion Time (24HR): 14:00:00

# Instruction Set
1. **Create a user account and login**
*User difficulty rating (Out of 5):* 4
*Supervisor comments*:
Didn't know that the date field is for date of birth

2. **Add $150 to your wallet**
*User difficulty rating (Out of 5):* 5
*Supervisor comments*:

3. **Search for a listing in kingsford**
*User difficulty rating (Out of 5):* 5
*Supervisor comments*:
Search bar is hard to see. Recommendation by user: make background
darker.

4. **Submit a bid on first listing in first property in search
results**
*User difficulty rating (Out of 5):* 3
*Supervisor comments*:

5. **Find the list of user's currently active bids**
*User difficulty rating (Out of 5):* 5
*Supervisor comments*:

6. **Navigate to the listing that was previously bid on without
searching the location**
*user difficulty rating (out of 5):* 5
*supervisor comments*:

7. **Message owner of the listing previously bid on**
*user difficulty rating (out of 5):* N/A
*supervisor comments*:

8. **Create a listing**
```

User difficulty rating (Out of 5): 4
Supervisor comments:
Cannot remove property item if accidentally press +add button.

9. **Navigate to the home page**
User difficulty rating (Out of 5): 5
Supervisor comments:

10. **Find the listing that was created without searching the location**
User difficulty rating (Out of 5): 5
Supervisor comments:

11. **Edit user profile**
user difficulty rating (out of 5): 5
supervisor comments:

12. **View user profile**
user difficulty rating (out of 5): 5
supervisor comments:

Overall Thoughts
Supervisor comments:
User likes the minimalistic design.

User comments:
User suggested to propagate ?next from login to registration.