

# Analysis of a Computerized Choice Selection System: The Case of a Public Sector General Univerisity

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# Introduction

## Choice Selection System

- Choice selection of courses in large public sector universities has always remained a critical matter. It is evident that, in such universities, thousands of prospective students compete for a limited number of seats allocated for specific undergraduate and postgraduate courses.
- The choice selection systems allows for the purposeful choices between multiple items (Aygünyand et al., 2013; Bo, 2014; Kamada et al., 2013; Fragiadakis et al., 2015)
  - Course
  - Category (e.g., Merit, Self-finance, Femal-quota, Employee-quota, etc.)
  - Shift/Session (e.g., Morning, Noon, and Evening)
  - Campus

# Introduction (Cont'd)

## Choice Selection System (Cont'd)

- There are many types of choice selection systems.
  - College/University Choice Selection System (A.Pathak et al., 2013)
  - School Choice Selection System (Dur et al., 2013)
  - Doctor Distribution (Abdulkadiroglu et al., 2003)

# Introduction (Cont'd)

## Choice Selection System (Cont'd)

- Global Public Sector General Universities
  - The global public sector universities have no restriction on disciplines.
- Pakistan Public Sector Universities
  - According to HEC, it excludes Medical and Engineering disciplines.

# Introduction (Cont'd)

## Public Sector Universities in Pakistan

- According to HEC policies, funding depends on total number of students
- The main goal of universities is to achieve maximum seat utilization.
- Employment ratio is determined by the number of students enrolled.
- Public sector universities are supposed to mainly operate in their prescribed jurisdictions.
- Each University has its own jurisdiction
- According to HEC, total number of public sector general universities are 80.
- Many sub-campuses are associated with these universities.

# Introduction (Cont'd)

## Challenges for the Public Sector Universities (PSU) in Pakistan

- Proper dissemination of the prospectus to the target candidates in rural areas.
- The candidates are unaware of ICT.
- Need for easy to use security/privacy-aware online admission systems.

# Introduction (Cont'd)

## Selection of a PSU in Pakistan

- University of Sindh is a large public sector general university.
- It has 6 sub-campuses.
- It offered 69 undergraduate degree programs (in year 2016).
- It had 6901 seats in these disciplines (in year 2016).
- 2/3 seats were reserved for Hyderabad and Mirpurkhas divisions.
- 1/3 seats were reserved for Sukkur and Larkana divisions.



# Introduction (Cont'd)

## Challenges of SU's Choice Selection System (Case study)

- Aligning schedule with the engineering and medical universities.
- Timely candidate registration.
- Transforming computerized admission system into interactive online system.
- Maximum seat utilization with fully automated admission system.
- Auditable students admission records to resit forgeries and frauds.

# Objectives

- Study of the existing computerized choice selection system of selected public sector general university.
- Identify the strengths and weaknesses of the selected system.
- Modify the existing algorithm to overcome the weaknesses (if any).
- Implement the new/modified system as a prototype.
- Providing implementation guidelines.
- Presenting the results and discussions.

# Problem Description

- Study the reasons behind under seat utilization
- Study the existing constraints over the choice selection system.
- Identifying the key constraints to maximize seat utilization.
- Adding more constraints over choice selections for improving the seat utilization.
- A prototype development of an online interactive choice selection system.

# Problem Description

## Why Seats are not utilized

- Reasons behind under seat utilization

# The Approach

- Case study: undergraduate courses' admissions in the University of Sindh
- Online interactive Prototype Design
- Compare with other policies
- Algorithm (Cormen et al., 2001) Design and Implementation
  - Suggestion Changing in algorithm
  - Analysis of algorithm with respect to space and time utilization
- Analysis of the seat utilization.
- Propose the candidate solution to automate the admission process in order to maximize the efficiency in seat utilization.
- Object modeling
  - Meta Model: UML 2 (Fowler, 2004) class diagram
  - Code generation using the class diagram

# Case Study

**Table :** Faculties and morning undergraduate courses

| Faculty               | Inst./Dept | Undergrad Courses | Seat Allocation |
|-----------------------|------------|-------------------|-----------------|
| Arts                  | 06         | 10                | 1037            |
| Commerce and Business | 02         | 02                | 377             |
| Education             | 04         | 01                | 111             |
| Islamic Studies       | 03         | 03                | 308             |
| Law                   | 01         | 01                | 183             |
| Natural Sciences      | 19         | 25                | 3403            |
| Pharmacy              | 04         | 01                | 111             |
| Social Sciences       | 14         | 13                | 1665            |
| <b>Total</b>          | <b>51</b>  | <b>69</b>         | <b>6901</b>     |

## Case Study (Cont'd)

### High-level admissions management use cases

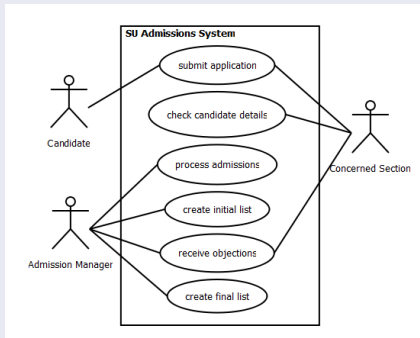


Figure : High-level admissions management use cases

# The Choice Selection Meta Model

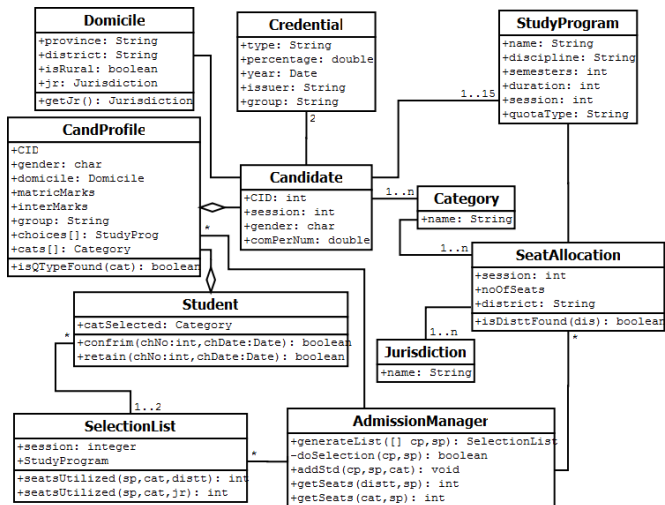


Figure : Meta model of the choice selection system



# The Choice Selection Algorithm

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## Algorithm 1 List Generation

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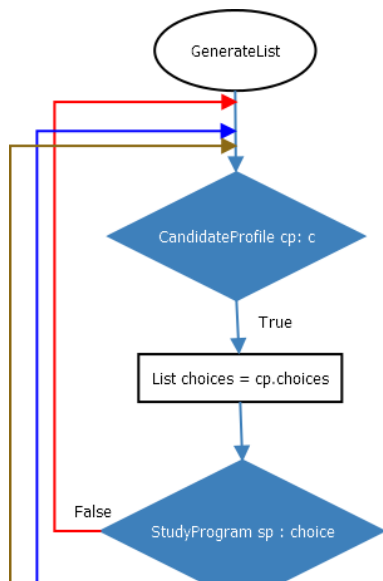
```

1: function GENERATELIST(CandidateProfile[] c, SeatAllocation s )
2:   for CandidateProfile cp: c do
3:     List choices = cp.choices
4:     for StudyProgram sp : choices do
5:       if SelectionList.getStd(cp.CID,sp) <> null then
6:         Break
7:       end if
8:       if AdmissionManager.doSelection(cp, s, sp) then
9:         Break
10:      end if
11:    end for
12:  end for
13: end function

```

Figure : List Generation

# The Choice Selection Algorithm (Cont'd)



# The Choice Selection Algorithm (Cont'd)


# Online Interactive Secure Model


- In this proposed model seat are more utilized
- After Entry Test student fill the choices.
- In this prototype student already know the last year CPN
- The Results are more accurated.

# Online Interactive Secure Model


## Secure Login



**Candidate Admission Application Form**





username and password case sensitive



[Privacy & Terms](#)




Figure : Secure Login

# Online Interactive Secure Model

## Fill Choices

Select Collage

HYDERABAD Govt: Boys College, Kali Mori, Hyderabad.

Please select Discipline

Red highlighted degree programs / disciplines / subjects indicates NO eligibility according to last qualification

Please select Discipline / Elective Subject \*

ARABIC (M.A)

ADD

| # | Name          | X |
|---|---------------|---|
| 1 | ENGLISH (M.A) | X |

← Previous   Next →

Figure : Secure Login

# Choice Based Seat Distribution

## Choice Based Seat Distribution

| Students (S <sub>n</sub> ) | Percentage | Preferences Courses(C <sub>i</sub> ) order (>) |
|----------------------------|------------|--|
| S1                         | 71         | C3,C1,C2                                       |
| S2                         | 72         | C1,C3,C2                                       |
| S3                         | 73         | C2,C1,C3                                       |
| S4                         | 75         | C2,C1,C3                                       |
| S5                         | 76         | C1,C3,C2                                       |

└

| C1 (2 seats) | C2 (1 seats) | C2 (1 seats) |
|--------------|--------------|--------------|
| S5           | S4           | S1           |
| S2           |              |              |

# Score Based Seat Distribution

## Score Based Seat Distribution

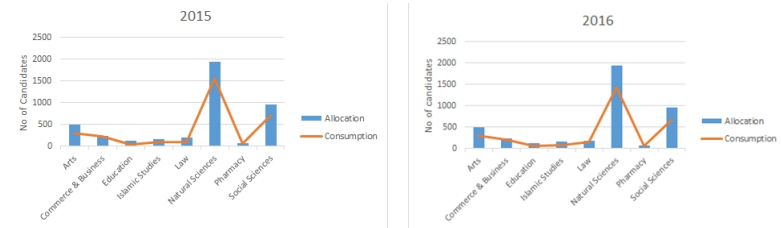
| Students ( $S_n$ ) | Percentage | Preferences Courses( $C_i$ ) order ( $>$ ) |
|--------------------|------------|--|
| S1                 | 71         | C3,C1,C2                                   |
| S2                 | 72         | C1,C3,C2                                   |
| S3                 | 73         | C2,C1,C3                                   |
| S4                 | 75         | C2,C1,C3                                   |
| S5                 | 76         | C1,C3,C2                                   |

□

| C1 (2 seats) | C2 (1 seats) | C2 (1 seats) |
|--------------|--------------|--------------|
| S5           | S4           | S1           |
| S2           |              |              |



# Total Seat Allocation and Utilization

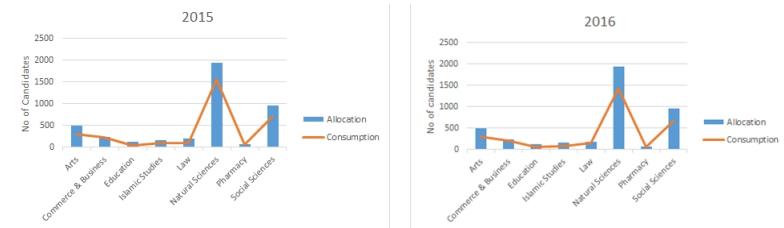


**Figure :** Total seat allocation and utilization

2015- 60% seats are consumed in Arts faculty, 74% seats in Commerce and Business, 93% in Education, 29% in Islamic Studies, 61 % in Law, 80% in Natural Sciences, 99% Pharmacy and 73% in Social Sciences.

2016- It was observed that 60% seats are consumed in Arts faculty, 90% seats in Commerce and Business, 50% in Education, 51% in Islamic Studies, 76 % in Law, 73% in Natural Sciences, 99% Pharmacy and 70% in Social Sciences.

# 2017 Total Seat Allocation and Utilization



**Figure :** Total seat allocation and utilization

2017- 60% seats are consumed in Arts faculty, 74% seats in Commerce and Business, 93% in Education, 29% in Islamic Studies, 61 % in Law, 80% in Natural Sciences, 99% Pharmacy and 73% in Social Sciences.

2016- It was observed that 60% seats are consumed in Arts faculty, 90% seats in Commerce and Business, 50% in Education, 51% in Islamic Studies, 76 % in Law, 73% in Natural Sciences, 99% Pharmacy and 70% in Social Sciences.

# Candidates' Choice Selection Trend in 2017

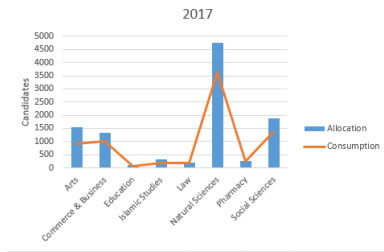


Figure : Total seat allocation and utilization

# Candidates' Choice Selection Trend in 2015-2016

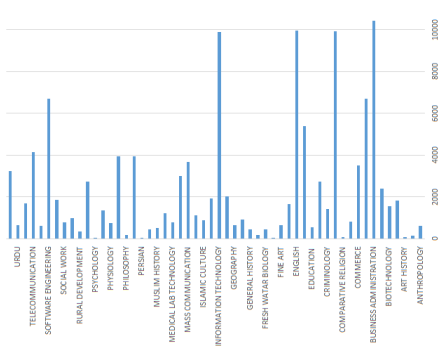


Figure : Candidates' choice selection trend in 2015-2016

University of Sindh offered 69 courses in 2015/16. A large number of students applied in market-oriented courses. The results of academic sessions 2015 and 2016 show that on average students specified maximum of 8 and 9 choices respectively. This suggests, that if we increase maximum number of choices to be specified by the candidates, we will have a probability of getting the good results in seat utilization.

# Candidates' Choice Selection Trend 2017



Figure : Candidates' choice selection trend in 2017

# Analysis of Algorithm with Respect to Space

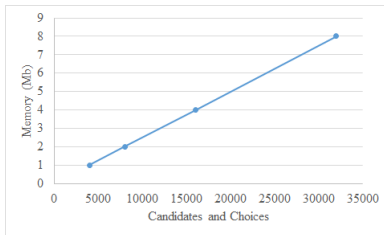


Figure : Total seat allocation and utilization

It thwas observed that 5000records takes 1 mb memory, 1000 records takes 2 MB , it is linear

# Analysis of Algorithm with Respect to Time

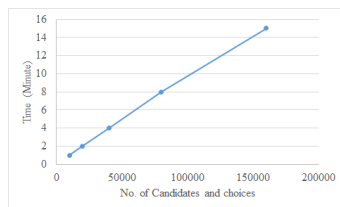


Figure : Candidates' choice selection trend in 2015-2016

It was observed that

# Comparison With Others Models

- O. Aygün and I. Bo [1], seats are distributed according to district where each district has its own fixed quota.
- A. Bhatia et al, seats are distributed according to their realms.
- University of Sindh adopted both polices.



# Related Work

| DISTRIBUTION OF ALLOCATED SEATS FOR BACHELOR DEGREE PROGRAM - 2016 |                                  |                                  |                                   |                            |                                    |                             |                |              |                |                                  |                          |                   |
|--|----------------------------------|----------------------------------|-----------------------------------|----------------------------|------------------------------------|-----------------------------|----------------|--------------|----------------|----------------------------------|--------------------------|-------------------|
| DISCIPLINE   | Quota/General Merit (Unreserved) | Upper Merit (Out of Reservation) | Female Quota (Out of Reservation) | Female Quota (Reservation) | Reserve Quota (Out of Reservation) | Reserve Quota (Reservation) | Disabled Quota | Sports Quota | Commerce Quota | South University Employees Quota | Affiliated College Quota | Total Merit Seats |
| FACULTY OF NATURAL SCIENCES  |                                  |                                  |                                   |                            |                                    |                             |                |              |                |                                  |                          |                   |
| Anthropology & Archeology (BS)                                     | 50                               | 10                               | 10                                | 1                          | 1                                  | 1                           | 0              | 10           | 2              | 85                               | 21                       | 5                 |
| Biochemistry (BS)  | 60                               | 10                               | 10                                | 1                          | 1                                  | 1                           | 0              | 10           | 2              | 95                               | 24                       | 5                 |
| Biotechnology (BS)   | 60                               | 5                                | 10                                | 1                          | 1                                  | 1                           | 0              | 10           | 2              | 90                               | 23                       | 5                 |
| Botany (BS)  | 85                               | 5                                | 10                                | 1                          | 1                                  | 2                           | 0              | 10           | 2              | 114                              | 29                       | 5                 |
| Chemistry (BS)   | 90                               | 5                                | 10                                | 1                          | 1                                  | 2                           | 0              | 10           | 2              | 121                              | 30                       | 5                 |
| Computer Science (BS) – PE   | 41                               | 20                               | 10                                | 2                          | 1                                  | 1                           | 0              | 10           | 2              | 87                               | 22                       | 5                 |
| Computer Science (BS) – PM   | 41                               | 20                               | 10                                | 2                          | 1                                  | 1                           | 0              | 10           | 2              | 87                               | 22                       | 5                 |
| Computer Science (BS) – PC   | 41                               | 20                               | 10                                | 2                          | 1                                  | 1                           | 0              | 10           | 2              | 87                               | 22                       | 5                 |

Figure : Seat Distribution

# Related Work

- In [1,2,3,5,7,13, 6], the authors developed the mathematical models.
- We used the object modeling approach to structure the system that dominates the programming paradigm. To the best of our knowledge, such an approach has not been used for the said purpose.

## Related Work

- Atila et al. [2] describe the selection of 8th and 9th grade candidates in New York City collage where the seats were divided into two portions.

| 50% Academic Perfomance |             |         | 50% Test Score |
|-------------------------|-------------|---------|----------------|
| 16 % lower              | 68 % Middle | 16% Top | Percentage     |

**Table :** Seat distributation of the New York City collages

# Related Work

- Dur et al. [10] mention seat distribution where 50% seats are assigned to neighborhood school priority and remaining 50% are on choice-base priority

# Related Work

## Choice Based Seat Distribution

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| S5                         | 76         | C1,C3,C2                                       |

└

| C1 (2 seats) | C2 (1 seats) | C2 (1 seats) |
|--------------|--------------|--------------|
| S5           | S4           | S1           |
| S2           |              |              |

# Related Work

## Score Based Seat Distribution

| Students (S <sub>n</sub> ) | Percentage | Preferences Courses(C <sub>i</sub> ) order (>) |
|----------------------------|------------|--|
| S1                         | 71         | C3,C1,C2                                       |
| S2                         | 72         | C1,C3,C2                                       |
| S3                         | 73         | C2,C1,C3                                       |
| S4                         | 75         | C2,C1,C3                                       |
| S5                         | 76         | C1,C3,C2                                       |

└

| C1 (2 seats) | C2 (1 seats) | C2 (1 seats) |
|--------------|--------------|--------------|
| S5           | S4           | S1           |
| S2           |              |              |

# Related Work

## Marriage Stability

| Boys Group | Preferences Girls | Girls Group | Preferences Boys |
|------------|-------------------|-------------|------------------|
| B1         | G1, G2, G3        | G1          | B2, B1           |
| B2         | G4, G5            | G2          | B5, B2           |
| B3         | G3                | G3          | B3               |
| B4         | G2, G1            | G4          | B2, B1           |
| B5         | G1, G3, G5        | G5          | B4, B5           |

# Related Work

## Doctor Distribution

- Many governments are concerned about access to health care in rural communities and trying to implement policies to balance the distribution of doctors in urban and rural areas [13].
- The study in [15], focuses on a problem of doctors distribution in Japan.



# Summary and Future Work

## Summary

- Modeling the existing choice selection system for public sector universities in Pakistan.
- The underlying model of the system is represented as a metamodel using UML class diagram notations. Such a model is exploited while designing the algorithm that generates the selection list.
- Analysis of the seat utilization
- The implementation reveals that the number of choices affect seat utilization. For instance, average choices were 8 and 9 in 2015 and 2016 respectively.

## Summary and Future Work (Cont'd)

### Summary (Cont'd)

- It was observed that 61% seats are consumed in Arts faculty, 93% seats in Commerce and Business, 26% in Education, 61% in Islamic Studies, 46 % in Law, 80% in Natural Sciences, 99% Pharmacy in 2015.
- It was observed that 60% seats are consumed in Arts faculty, 89% seats in Commerce and Business, 50% in Education, 51% in Islamic Studies, 76 % in Law, 74% in Natural Sciences, 99% Pharmacy.
- It is evedient that the seat utilization can be improved by increasing the number of minimum choices (e.g., fifteen).

# Summary and Future Work (Cont'd)

## Future Work

- Study the reasons behind under seat utilization.
- Identifying the key constraints to maximize seat utilization.
- Adding more constraints over choice selections for improving the seat utilization.
- A prototype development of an online interactive choice selection system. For instance, adapting an on-line open-house based process to utilize the left-over seats for the prospective students.
- Guidelines for further implementation.

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