DESERT at
Hospital Lillebælt
Region of Southern Denmark

Agenda

- Region of Southern Denmark (RSD) & Hospital Lillebælt
- RSD and SAS's joint AI journey
- Project:
  - Background
  - Aim/purpose
  - Roadmap
- PSD Project definition
- Solution
  - Data flow
  - Constraints and requirements
  - Code
- Thoughts on improvement

- → Questions? Write in the chat and the moderator will fit them in, either during presentation or Q&A as appropriate
- → No specific results will be shared

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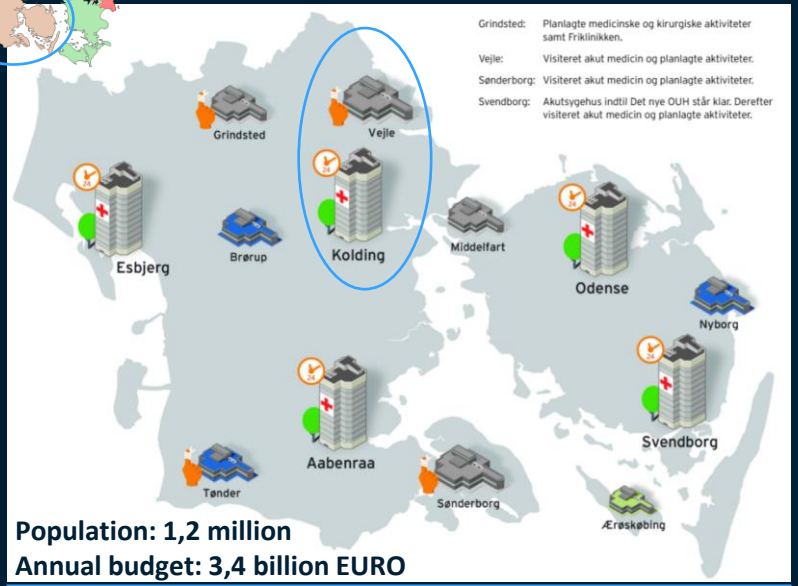
Region of Southern Denmark



Population: 1,2 million
Annual budget: 3,4 billion EURO

Hospital Lillebælt in numbers:

Admitted patients in 2020:
- 48.400 hospital admissions
- 2,9 bed days
- 132 admissions per day

Outpatient visits in 2020
- 516.500 visits (excl. x-ray)
- 2.064 daily visits

Bed capacity in 2020
- 568 beds

The Region of Southern Denmark is responsible for running and administrating the healthcare service in Southern Denmark.

Responsibilities:

- Running the four hospital units in the region and ensuring that patients receive timely treatment of the highest quality
- Providing a pre-hospital system with supplementary pre-hospital input over and above the ambulance service
- Working with 800 GPs to provide medical care
- Subsidising medicine and treatment by dentists, physiotherapists, chiropodists, chiropractors and psychologists
- Working with GPs and the 22 local authorities to ensure the best possible coherence in the patient process for citizens

Source: https://regionsyddanmark.dk/en

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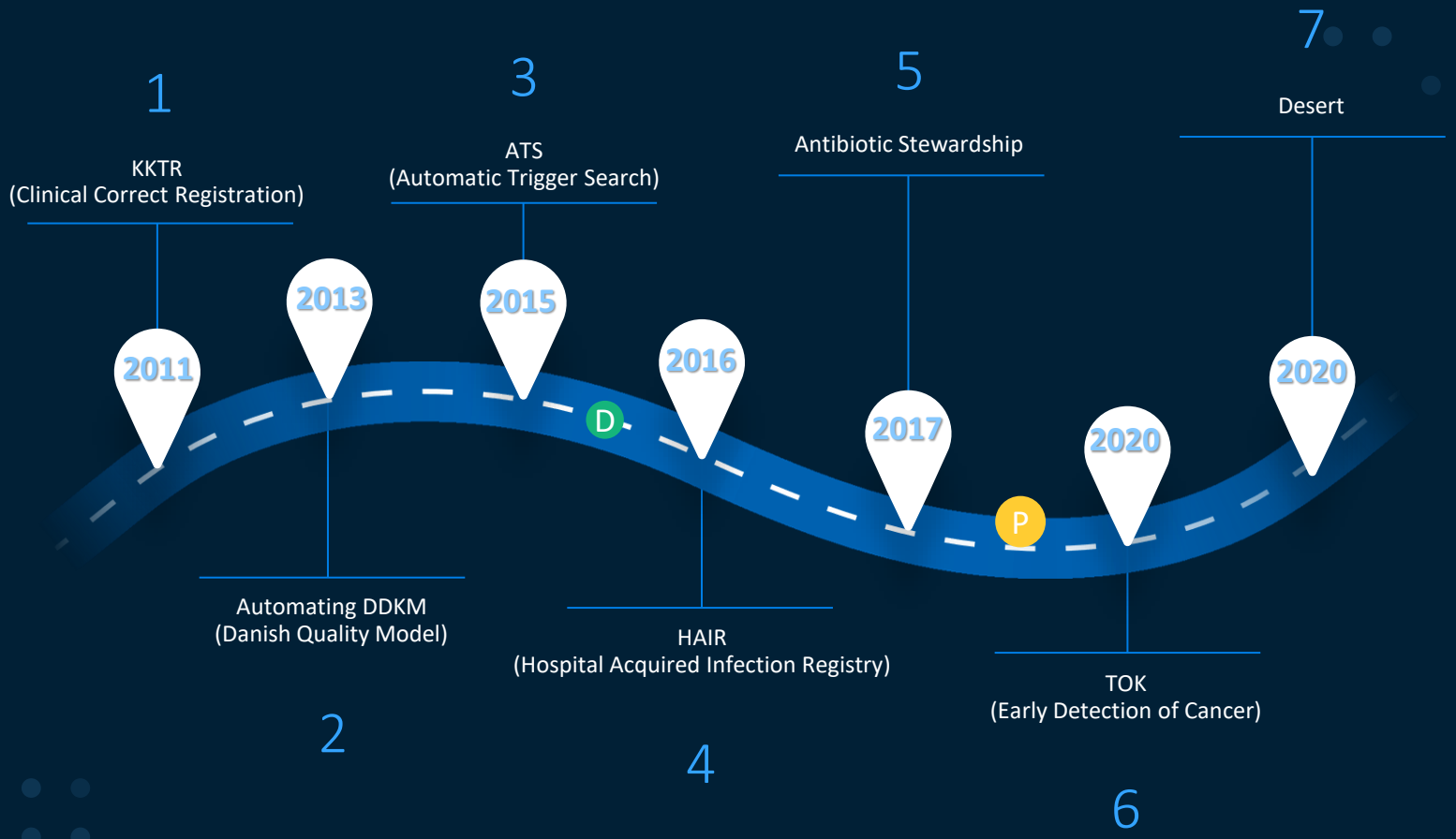

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Strategic partnership

Purpose of partnership
- Reuse fantastic data in a trusted research environment (TRE)
- Making better decisions based on data and Analytics

We need new competencies and data scientists

Develop best practice in how to deploy AI solutions in the organization

Innovation platform for testing and deploying AI algorithms

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Project DESERT – A Danish Lighthouse Project

Fast and augmented diagnostics in Acute Departments

Project DESERT trains an artificial intelligence-based decision support system to better detect critical condition in acute patients and rank probabilities for a range of frequent life-threatening conditions based on diagnostic blood and urine tests

In 2020 the government, Danish Municipalities and Danish Regions made an investment fund that supports testing of new technologies in the public sector.

The investment fund supports a number of projects using artificial intelligence in the public sector. The projects are also called lighthouse projects with artificial intelligence.

- Read more about the project

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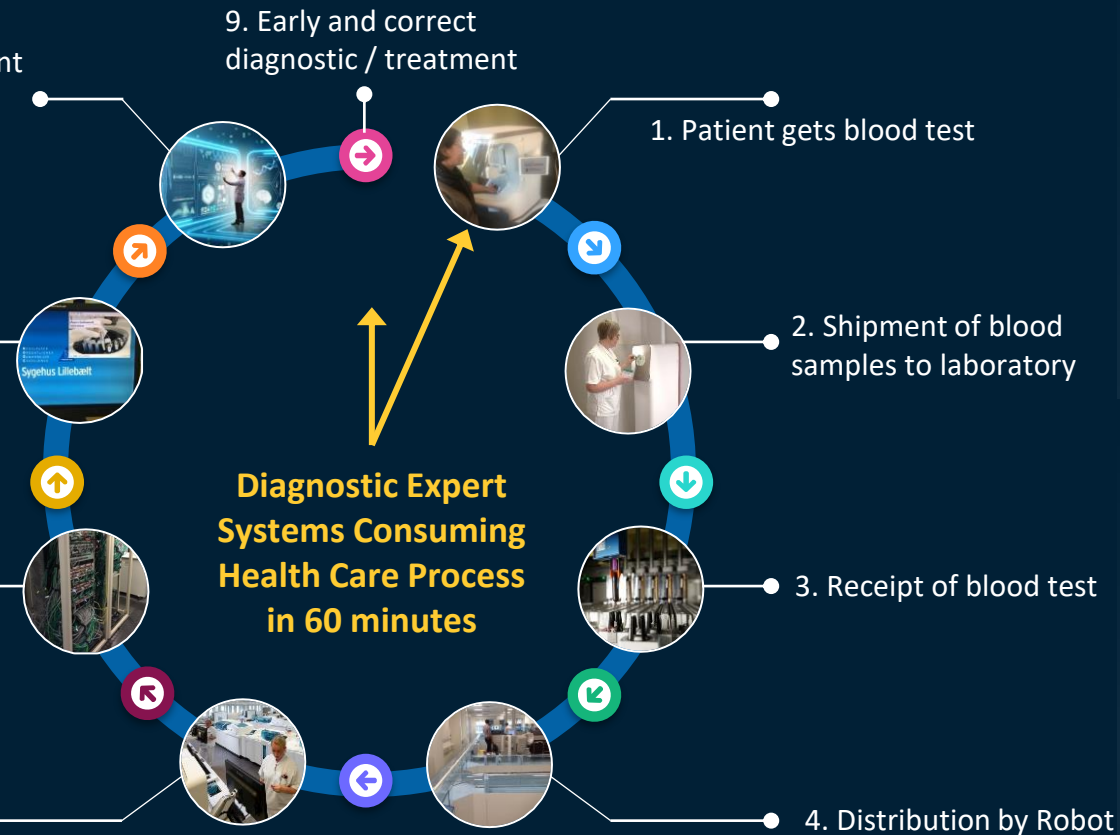
Fast and augmented diagnostics in Acute Departments



Project Data:
240 Biomarkers
Medicine
Vitals
ECG
PT Demographic

Outcome data;
diagnosis,
death,
ICU,
sepsis,
uncomplicated

Price example:
Biomarker pricing between x – xxx dkr.

If avg. price = 10 dkr.
Then 240 biomarkers
From 9000 patients
= 21.600.000 dkr.
→ Not sustainable

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Desert Success Criteria

Shorter hospital stay – 0,5 day

Reduced mortality – 10-20%

Reduced readmission number by 20% (12%! <30 days)

Reduced critical outcomes – sepsis (20% of all dead)

Reduced use of intensive care units

No of deaths within 30 days of discharge reduced by 20%.

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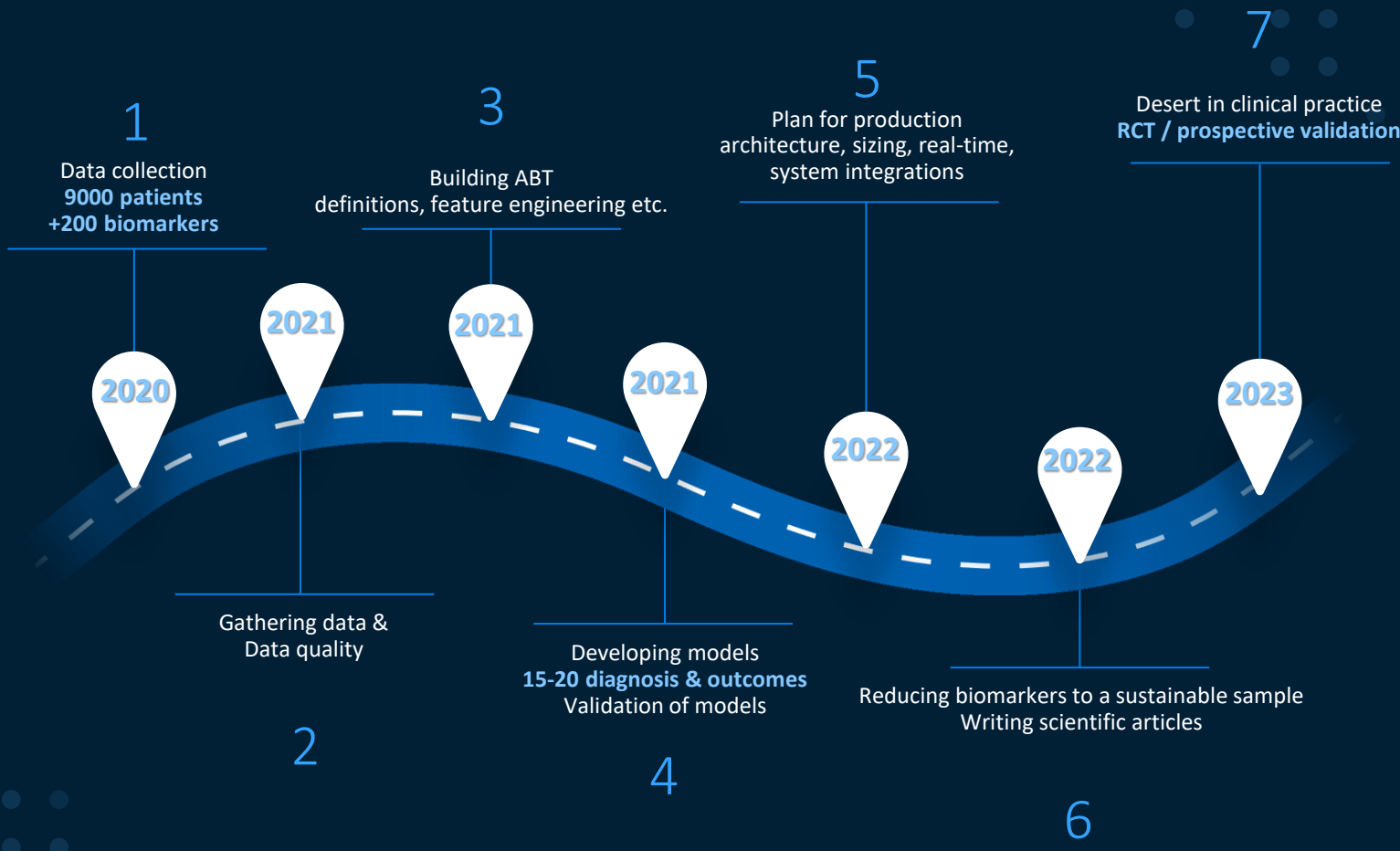

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Media interest

Akutpatienter kan hurtigere få den rette behandling

Patienten kan endnu hurtigere få stillet den rette diagnose og undgår ekstra blodprøvestik. Det er de foreløbige erfaringer af et stort projekt med kunstig intelligens, som Sygehus Lillebælt er midt i.

13. april 2021 | Tekst: Søren Hygum Hansen | Behandling

Det står ofte ikke umiddelbart klart, hvad en patient, der ankommer syg til Akutafdelingen på Kolding Sygehus, fejler. Symptomerne og smerterne kan pege i mange forskellige retninger.

En præcis diagnose kræver derfor flere undersøgelser - og måske også flere blodprøvesvar end først forventet. Og siden efteråret har lægerne i den såkaldte zone 2 på Akutafdelingen i Kolding og på Akut Visitationsafsnit i Vejle kunnet få op til fem gange flere svar fra ét enkelt blodprøvestik, end de har kunnet få førhen. De mange ekstra svar betyder, at personalet i flere tilfælde hurtigere kan hjælpe patienten, der skal have akut behandling.
- Det giver os nogle muligheder for hurtigere at kunne stille den helt rette diagnose, siger Dorte Patuel Andersen, som er afdelingslæge i den medicinske zone på Akutafdelingen.

De mange ekstra blodprøvesvar kommer som et led i udrulningen af det store, ambitiøse DESERT-projekt, som sygehuset er midt i. Et projekt, der har fået opmærksomhed udenfor landets grænser, og hvor Sygehus Lillebælt i en nær fremtid vil bruge kunstig intelligens til at få et forslag til, hvad en akutpatient med forskellige symptomer kan fejle.

En stor hjælp i arbejdet

En sådan akutdiagnose kræver flere blodprøveanalyser. Derfor har sygehuset over de seneste par år gjort det muligt at femdobl
Kolding
- Det er
hjælper

Normalt
tilstand.
efterbest
30 til hel

Kunstig Intelligens skal understøtte effektiv akut diagnosticering

Rasmus Elm Rasmussen 11 februar 2022 AOD Pro 0 kommentarer

orsinkelser i diagnostik af akutte patienter k
en kunstig intelligens ser ud til at kunne bli
at speede processen op. Erfaringen gøres
vor man undersøger, hvad brug af kunstig in
atienterne

r en patient ankommer til en akutafdeling, kan symptomerne pege i ma
den patienten er diagnosticeret og i behandling, kan være afgørende. E
Sygehus Lillebælt forventes at vise, at når kunstig intelligens prioritere
kan patienter hurtigere få den rigtige behandling.

t ambitiøse projekt som kaldes DESERT er banebrydende og har aller

Hurtig diagnosticering med kunstig intelligens sikrer hurtig og korrekt behandling

TV SYD PLAY SØG SE MERE

VEJLE SUNDHED

Supercomputere skal stille lynhurtige diagnoser

Af Peter Elgaard

15. okt 2019, kl. 10:01 Artiklen er mere end 30 dage gammel

LÆS ARTIKLEN OP

Sygehus Lillebælt i Vejle modtager 8,7 millioner kroner til projekt, der skal

BUSINESS PARK

Nu har vi bevis for det, publiceret internationalt, fortæller Ivan.

Kunderedrevet innovation

Når SAS Institute er skarpe på løsninger til sundhedsvæsenet, er det ikke alene, fordi man har dygtig
lave algoritmerne. Forretningskonsulenterne, der forstår kundens problemstilling, er lige så vigtige.

– Vi kan udvikle de her løsninger, fordi vi forstår kunderne. En af vores vigtigste værdier er brugerdr
innoverer vi ikke ved skrivebordet men ude sammen med kunderne. I SAS tænker vi stort, og det er
som har lyst til at gå turen sammen med os, at vi kan gøre en forskel, slutter Morten.

I laboratoriet på Sygehus Lillebælt i Vejle: En tæt kontakt og gode dialoger er afgørende for både Morten Krogh Danielsen og Ivan

Event skabte opmærksomhed hos fond

AI Innovation House har et mål om at være innovationslegeplads for digitalisering og kunstig intelli
et godt match mellem huset og SAS Institute. Et godt match opstod også, da Morten Krogh Daniels
1. november 2021 havde et indlæg på husets konference: 'AI og sundhedsdata – yndlingsdrink eller sprængfarlig cocktail'. En
konference, hvor Ivan Brandslund også deltog, og hvor ideen om Sygehus Lillebælt som et AI hospital blev bragt i spil.

JP Vejle

JP LOKAL / JP VEJLE

Kunstig intelligens: Indlagte patienter kan se frem til at få stillet en diagnose i løbet af én time i Vejle

Sygehus Lillebælt i Vejle samarbejder med SAS Institute om brugen af kunstig intelligens, og det gør det blandt andet muligt at forudsige risikoen for at udvikle kræft i løbet af 90, 180 og 360 dage - og i 2022 er en model klar, som sandsynligger en diagnose væsentlig hurtigere end i dag.

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PSD Project Scope

- Goals
  - Demonstrate that models work well in predicting outcomes
  - Explore which pieces of information are important for diagnoses and (importantly) which can be omitted
  - Demonstrate that deployment of models is feasible
  - Enable customer to use and expand the modelling & framework

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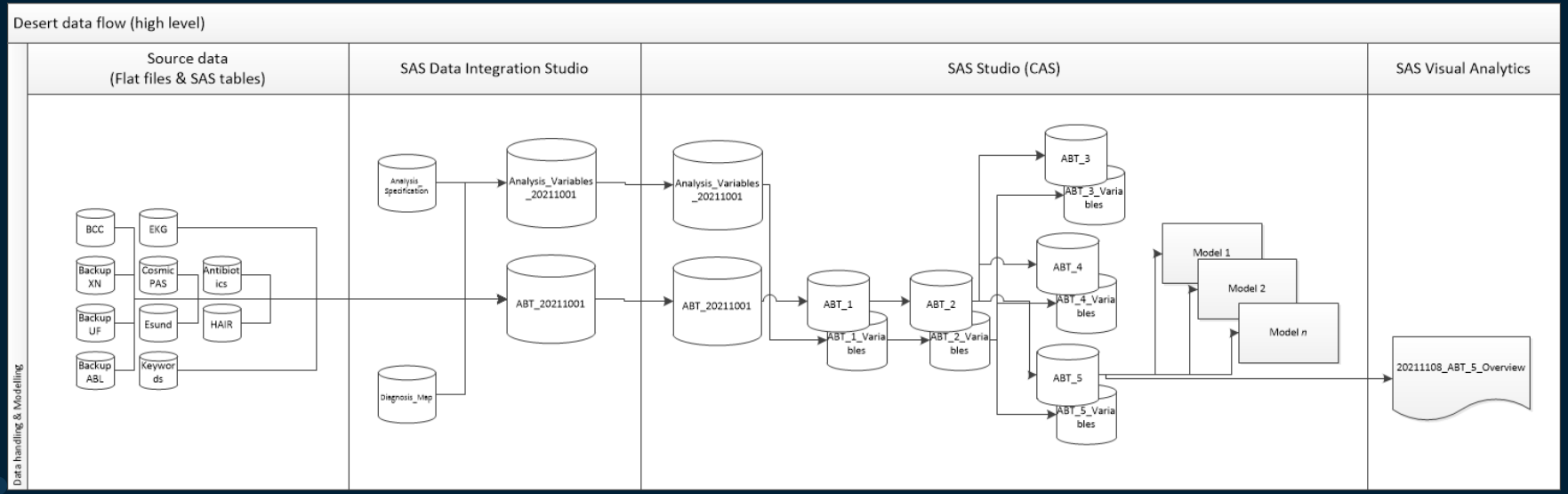
Solution (1)

Data Flow



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Solution (7)

Modelling Tools

- Implementation in SAS Studio (alternative: Model Studio)

- Main motivations
  - Requirements for replicating ABT setups many times (without spending time on repeating input variables setup)
  - Requirements for supporting “variable packages” during modelling - logical groupings of input variables, typically corresponding to data source and data type (and adding these in a forward stepwise-selection fashion)
  - Requirement on documentation and traceability of calculations, especially around cross validation and hyperparameter tuning

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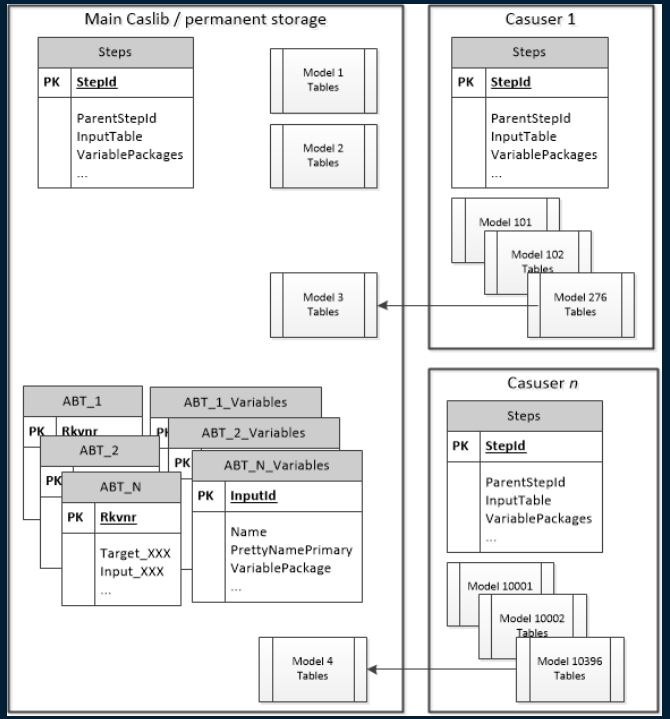
Solution (8)

Approach

- Models & metadata stored
  - One caslib is considered ”permanent” while users are allowed to build models in other caslibs (such as their own ”casuser” caslib).
  - Migration of chosen models to permanent storage only after selection is done.
  - A single, central, metadata table ”steps” contains links & metadata about each analysis step done (ABT transformation & modelling)
- Model artifacts stored
  - Models (astores)
  - Scores(from both ”submodels” and ”overall” model) & outcomes
  - Performance statistics & graph underpinnings



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Solution (9)

Example

Start Page | * Program.sas ×

Run | Cancel | Copy to My Snippets | Debug

Code | Log

```
%Experiment(StartStepId     = 1900,
            macro           = buildGbst,
            fixedParms      = %STR(PreviousStepId=5, Outlib=casuser, TargetVar=Target_Death_7days_Flg, Metadata=casuser.Steps),
            fixedPackages   = Blood Diagnosis EKG KEY_Physical,
            tryPackages     = Blood_XN Blood_ABL Blood_Exp Antibiotics Backup_ABL Backup_ABL_Corr Backup_UF Backup_UF_Corr Backup_XN,
            hyperParms      = %STR(&DefaultGridGbst.),
            debug           = 0)


%LET models =  %createList(1900,2026);
%printModelComparison(StepId = &models., ReportName=compare_Death_7day_HO_Gbst1.pdf, ReplaceAllowed=1)


*   Final registration;
%copyModel(StepId=1936, NewStepId=1801, SourceMetadata=casuser.steps, DestinationMetadata=desert.steps)
%printModel(StepId=1801, Metadata=desert.Steps, ReportName=Rpt_HO_Target_7_Death_Flg_1801.pdf, ReplaceAllowed=0)
```

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Solution(10)

Utility macro examples

- Macros for handling tables (selected)
  - **storeTable**: Macro for maintaining table state (promotion & saving) based on session a scope table.
    - Quite useful to avoid repetitive handling of table status
  - **reloadSavedTables**: reloads .sashdat files in a caslib into memory if they are not already present – possibly subsetting to tables with a specified name-prefix.
    - Babys first CASL program ☺
  - **clearCaslib**: removes tables (with a name-prefix) from memory and potentially from backingstore
    - Dangerous if executed without table prefix!
    - Good for cleaning up casuser with 100+ tables quickly

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Solution(11)

Metadata macro examples

- **createMetadataTable**: initial datamodel (single table DDL)
- **createStep**: insert row into steps table
- **updateStep:** update an existing step with additional information.
- **deleteStep(s):** removal of one or more steps.
- **extractPackages:** generation of macro variables containing column names based on selected variable package names.
- **copyModel:** make a copy of a model across caslibs

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Solution(12)

Modelling macro examples

- **Experiment**: main wrapper macro. Specifies modelling macro to run, including hyperparameter settings and variable packages to test. Creates one step for each model (set).
- **buildGBST**: example macro for wrapping PROC GRADBOOST.
- **empiricalProbability:** taking a fixed set of cutoffs, use balanced boostrap samples to estimate confidence limits on group target-prevalence from the holdout sample.
- **variableReduction:** functionality to re-estimate a large set of ”final models” removing individual or small groups of inputs (not full packages) in a sequence to assess the k-fold change in performance. Used to inform the tradeoff between price and model precision.

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Questions?

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