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1) Topic Name

RentConnect-C3AN: Neurosymbolic Student Housing & Roommate Orchestration

2) Description (use-case driven, C3AN aligned)

RentConnect-C3AN is a mobile platform that helps university students find safe, affordable off-campus housing and compatible roommates. It uses a **Custom, Compact, and Composite** neurosymbolic approach: neural modules parse messy listings and images; a **symbolic knowledge graph** encodes Fair Housing rules, campus zones, lease/utility constraints, transit timetables, and landlord policies; a **planner** composes decisions (ranking, matching, routing) with human-in-the-loop review for trust and safety. This instantiates C3AN's pillars (intelligent, robust, trustworthy) and draws on its 14 foundation elements (e.g., Reliability, Alignment, Reasoning, Planning, Grounding, Explainability, Safety). *sup_3__sup* AN_ Custom Compact and Composite AI Systems - A N.pdf

Primary use cases

- **Student-aware search & ranking:** multi-criteria scoring over budget, commute (walk/transit/drive), safety overlays, amenities, lease terms.
- **Constraint-aware roommate matching:** stability under **hard** rules (no smoking, pet policy, quiet hours) and **soft** preferences (cleanliness, schedules), with fairness checks.
- **Tour planning around classes:** time-windowed routing that sequences property visits between class blocks and bus headways.
- **Listing risk screening:** anomaly/scam detection on text/images; landlord verification workflow; transparent flags and appeals.
- **Compliance nudges:** UX guardrails to keep onboarding and filters Fair-Housing-compliant.

Tech stack

- **App:** React Native (iOS/Android)
- **Auth/DB:** Firebase Auth + Firestore; storage for docs/photos
- **Hosting/CI:** Vercel (services/landing) + Google Cloud Functions (scoring/matching jobs)
- **Reasoning layer:** Python services for ranking/matching/routing; lightweight models (distilled/edge-friendly) + knowledge-graph store

3) Gap in Current Systems vs What We're Solving

Current Systems & Pain Points	Impact on Students	RentConnect-C3AN Solution	Why It Requires Composite Reasoning
Generic portals (Zillow et al.) ignore student context	Missed needs; higher search cost	.edu verification, student-centric filters, lease/room-split metadata	Identity + policy knowledge + dedup across sources
Facebook/Craigslist noise & scams	Safety risk; wasted time	Risk scoring on text/images + verifiable landlord workflow	Neural anomaly detection + rule checks + human review
"Vibe-based" roommate posts	Mismatches; lease churn	Stable matching with hard/soft constraints & fairness	Multi-objective optimization + constraint satisfaction

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Manual budget/commute tradeoffs	Suboptimal choices	Multi-criteria ranking (budget, travel time, safety)	Feature scaling + Pareto/learned weights + explanations
Tour logistics around classes	Few viewings; decision fatigue	Time-windowed routing across class blocks & GTFS	ILP/heuristics + schedule/GTFS constraints
Compliance knowledge buried	Biased filters; policy risk	FHA-aware UX nudges & rule validators	Symbolic policy rules + UI guardrails + attribution
Unclear utilities/cosigners	Surprise costs	Split-payment simulations & checklist flows	Financial modeling + doc state machine

4) Dataset Sources

Core housing and listings datasets

- **Market rents: Zillow ZORI (Observed Rent Index):** Metro/county/ZIP-level time series of asking rents; useful for price baselines, affordability filters, and trends. https://www.zillow.com/research/data/
- **Market rents: Redfin Rental Market Data:** Downloadable series for median asking rent and rental trends; complements ZORI with multifamily focus. https://www.redfin.com/news/data-center/rental-market-data/
- **National listings snapshots: USA Housing Listings (Kaggle):** Aggregated rental listing records across the U.S. for model prototyping (amenities, prices, text). https://www.kaggle.com/datasets/austinreese/usa-housing-listings
- **Craigslist rentals (Kaggle):** Historic rental posts (Bay Area/SF examples) with descriptions, price, and features—good for NLP on amenities and messaging heuristics. https://www.kaggle.com/datasets/michaelbryantds/bay-area-craigslist-rentals/versions/1

Columbia/USC-local context layers

- **City of Columbia Open Data Portal (GIS):** Zoning, neighborhoods, code enforcement, and rental property viewer—ideal for proximity filters and compliance checks around USC. https://gis.columbiasc.gov/
- **Richland County GIS (Parcels/WMS):** Parcel boundaries, addresses, and zoning via web mapping services; helpful for geocoding and bounding searches near campus. https://www.richlandcountysc.gov/Property-Business/Mapping-and-Records/Geographic-Information-Systems
- **Transit access: The COMET GTFS feed:** Stop locations, routes, and schedules to compute transit times to campus and bus-accessible listings. https://www.transit.land/feeds/f-dnn3-thecomet~sc~us

Roommate matching datasets (behavioral/preferences)

- **Big Five personality test responses (Kaggle):** Large OCEAN datasets suitable for training compatibility scoring (e.g., conscientiousness + quiet hours analogies). https://www.kaggle.com/datasets/tunguz/big-five-personality-test

Affordability and compliance datasets

- **HUD Fair Market Rents (FMR):** County/metro rent benchmarks for voucher eligibility, affordability scoring, and price sanity checks. https://www.huduser.gov/portal/datasets/fmr.html
- **HUD USER datasets index:** Central landing for additional housing data (LIHTC, income limits, policy data) useful for compliance reviews. https://www.huduser.gov/portal/pdrdatas_landing.html
- **Census ACS via API:** Housing, demographics, commute, and income variables at tract/block-group—supports equity analysis, neighborhood scoring, and Fair Housing context. https://www.census.gov/programs-surveys/acs/data/data-via-api.html

5) "Need for Knowledge" (C3AN-oriented)

A. Domain & Policy Knowledge (symbolic)

- Fair Housing Act + local ordinances; campus housing norms; lease/cosigner/utility rules encoded as constraints and UX guardrails.

B. Structured World Knowledge (knowledge graph)

- Entities/relations: Property ↔ Landlord ↔ Amenities ↔ Transit Stop ↔ Campus Building ↔ Safety Event ↔ Policy Rule; taxonomies for amenities, lease types, roommate preferences.

C. Algorithms & Reasoning (neural + symbolic)

- **Ranking:** multi-objective scoring (budget, commute, safety, amenities) with user-tunable weights and Pareto explanations.
- **Roommate matching:** stable matching under constraints, soft-preference weighting, tie-break fairness.
- **Tour planning:** time-windowed routing with GTFS headways and class blocks.
- **Risk screening:** text/image anomaly detectors + rule filters + human escalation.
- **Explainability/Attribution:** show "why" for ranks/matches/flags with tracebacks to rules, data sources, and model features.

D. Reliability, Safety, Trust (C3AN foundation elements)

- **Reliability & Consistency:** deterministic pipelines; idempotent ranking; property dedup.

- **Alignment & Safety:** FHA-aware prompts/filters; prohibited criteria blocked; incident reporting.

- **Grounding & Attribution:** link outputs to real entities/sources; cite data feeds and rules.

- **Interpretability & Explainability:** short, user-facing rationales; admin drill-downs.

- **Instructability:** adapt weights/constraints from user input without retraining; store as rules.

- **Abstraction/Analogy/Causality:** abstract features (e.g., “walkability”), analogize transit patterns across neighborhoods cautiously, and avoid spurious correlations (policy-backed causal priors). *sup_3__sup* AN_ Custom Compact and Composite AI Systems - A N.pdf

E. Product & Ops

- Metrics: lease conversion rate, days-to-decision, fraud FP/FN, match acceptance, tour efficiency.

- Human-in-the-loop ops (appeals, landlord verification), audit logs, privacy & consent flows.

- **Compactness plan:** small/distilled models, server-side batching, edge-friendly on-device scoring where feasible; domain-scoped KG to keep reasoning fast. *sup_3__sup* AN_ Custom Compact and Composite AI Systems - A N.pdf

First Draft Workflow – RentConnect-C3AN

Agents

- **Data Ingestion Agent** – Collects and cleans property listings, roommate surveys, and safety data.
- **Knowledge Graph Agent** – Stores rules and relationships (Fair Housing Act, campus zones, transit data).
- **Listing Analysis Agent** – Uses AI to detect scams and extract listing details.
- **Roommate Matching Agent** – Matches students using preferences and constraints.
- **Ranking & Scoring Agent** – Ranks housing options by price, commute, and safety.
- **Route Planning Agent** – Plans property tour routes around class schedules.
- **Compliance & Safety Agent** – Checks listings against housing regulations and safety data.
- **Explanation Agent** – Generates short, clear explanations for results.
- **Feedback & Learning Agent** – Updates recommendations from user and expert feedback.
- **Orchestration Agent** – Coordinates data flow and connects all agents together.

Resources and Tools

- **Frontend:** React Native, Expo
- **Backend / Database:** Firebase (Auth + Firestore), optional Python services
- **Knowledge Representation:** Neo4j or Firestore for knowledge graph
- **AI Models:** TensorFlow Lite or PyTorch Mobile for scoring and matching

- **Data Sources:** GTFS feeds, OpenStreetMap, Google Distance Matrix, city open data, HUD datasets

- **Deployment:** Vercel (frontend), Google Cloud Functions (backend)

- **Development Tools:** VS Code, npm, Node.js, GitHub

- **Testing:** Postman, Jest, Python unit tests