# NLG Lecture 8:
# Content planning 2

Adapted from slides by Jon Oberlander

With thanks to MATCH and ILEX projects

School of informatics



## Text planning in MATCH

- MATCH (2002-7):
  - Multimodal (text, speech, graphics/gestures)
  - Restaurant recommendation
  - Uses a text planner to map from communicative goals to text plans
- Key points:
  - Can achieve two types of goal (compare, recommend)
  - Includes a decision-theoretic model of user preferences
  - Allows control of conciseness (important in a spoken dialogue context)
  - Given a goal and a user model, selects content, derives multiple possible text plans
- Related system:
  - ILEX (1996-2001) and MPIRO: multimodal museum object description
  - User modelling, discourse modelling, bottom-up
- Later in course:
  - Given (a set of) text plans, generate (a set of) sentence plans



## MATCH goals

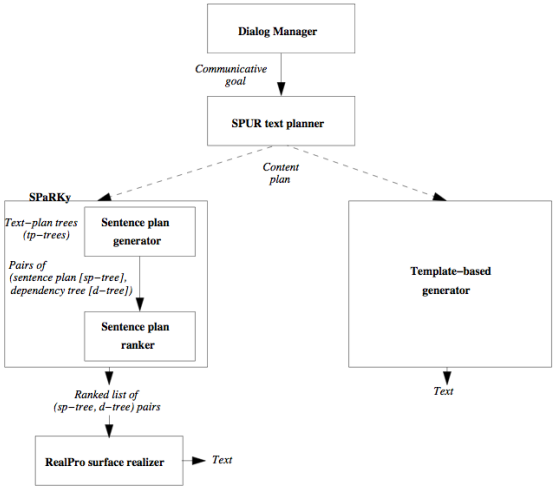
Make it easier for users to understand the tradeoffs between different options by:

1. Responding to requests for recommending one restaurant or comparing small sets of restaurants
2. Tailoring recommendations and comparisons to a model of the user's individual preferences
   - Ranking options
   - Selecting attributes to mention
3. Making responses sufficiently concise for the user to understand and remember important information



## MATCH: multimodal access to city help

## MATCH architecture: focus on SPUR






## MATCH: multimodal input-output

| | |
|---|---|
| U1 | *"Show me Italian restaurants in the West Village"* |
| S1 | [zooms to the West Village, displays Italian restaurants. (Figure 3)] |
| U2 | [circles a selection of restaurants and says *"compare"* (Figure 4)] |
| S2 | *"Among the selected restaurants, the following offer exceptional overall value. Uguale's price is $33. It has excellent food quality and good decor. Da Andrea's price is $28. It has very good food quality and good decor. John's Pizzeria's price is $20. It has very good food quality and mediocre decor."* |
| U3 | [writes word "recommend"] |
| S3 | *"Uguale has the best overall value among the selected restaurants. Uguale's price is $33."* |



## S1 - Response to "Show me Italian restaurants in the West Village"

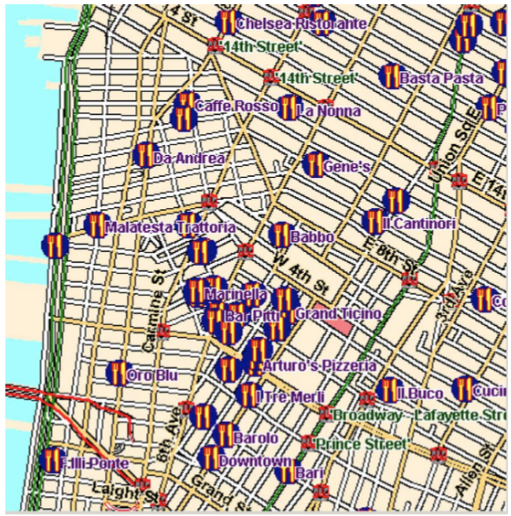



Fig. 3. MATCH's graphical system response to *Show me Italian restaurants in the West Village*.



## U2 - multimodal comparison request


Fig. 4. User circles subset of Italian West Village restaurants for comparison.

## Evaluative arguments: Carenini & Moore on recommendation and comparison

1. Identifying supporting and opposing evidence:
   - evidence must be based on a model of the user's values and preferences, e.g., superb restaurant decor can only be used to support an argument for going to a restaurant if the user is oriented to decor.
2. Positioning the main claim:
   - placing the main claim first helps users follow the line of reasoning, but delaying the claim until the end of the argument can also be effective if the user is likely to disagree with the claim.
3. Selecting supporting and opposing evidence:
   - an argument cannot include all the possible evidence, so only strong evidence should be presented in detail, and weak evidence only briefly mentioned or omitted entirely.
4. Arrangement of supporting evidence:
   - the strongest support should be presented first but, if possible, one effective piece of supporting evidence should be saved for the end to leave the user with a final impression of the strength of the argument.
5. Addressing and ordering opposing evidence:
   - the choices are not to mention any opposing evidence, to acknowledge it without refuting it, or to acknowledge it and refute it. The opposing evidence should be presented so as to minimize its effectiveness with strong opposing evidence in the middle and weak evidence at the beginning and end.
6. Ordering between supporting and opposing evidence:
   - if the reader is aware of the opposing evidence, then it should come before the supporting evidence, otherwise after.



## One dimension of variation: conciseness of output

Conciseness: mention only those restaurants and attributes that are most relevant to the user's preferences

| User | Conciseness | Output |
|---|---|---|
| CK | Concise (z= 0.3) | Bond Street has the best overall value among the selected restaurants. Bond Street has excellent food quality. |
| BA | Concise (z= 0.3) | Komodo has the best overall value among the selected restaurants. Komodo's price is $29. It's a Japanese, Latin American restaurant. |
| CK | Sufficient (z= -0.7) | Bond Street has the best overall value among the selected restaurants. Bond Street's price is $51 and it has excellent food quality and good service. It's a Japanese, Sushi restaurant. |
| BA | Sufficient (z= -0.7) | Komodo has the best overall value among the selected restaurants. Komodo's price is $29 and it has very good service and very good food quality. It's a Japanese, Latin American restaurant. |
| CK | Verbose (z= -1.5) | Bond Street has the best overall value among the selected restaurants. Bond Street's price is $51 and it has excellent food quality, good service and very good decor. It's a Japanese, Sushi restaurant. |
| BA | Verbose (z= -1.5) | Komodo has the best overall value among the selected restaurants. Komodo's price is $29 and it has very good service, very good food quality and good decor. It's a Japanese, Latin American restaurant. |



## Another dimension of variation: user modelling

- Multi-attribute utility theory:
  - A preference for something is generated by a number of factors (attribute-value pairs)
  - Weights can be attached to those factors by eliciting user preferences on a range of stimuli
  - Good approximation of weightings via ranking of K attributes (what single attribute would you change to improve on worst restaurant? etc.)

$$w_k = \frac{1}{K}\sum_{i=k}^{K}\frac{1}{i}$$

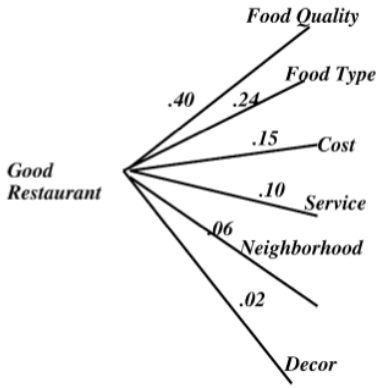



Fig. 6. Structure of objectives for MATCH.



## Three user models: BA, CK, OR

- Differ in weights on attributes

| User | FQ | SVC | Dec | Cost | Nbhd | FT | Nbhd Likes | Nbhd Dislikes | FT Likes | FT Dislikes |
|---|---|---|---|---|---|---|---|---|---|---|
| BA | 0.10 | 0.16 | 0.06 | 0.24 | 0.03 | 0.41 | Downtown, Midtown, E. Village, TriBeCa SoHo | The Bronx, Harlem | Cajun Creole, Greek, Italian, Japanese, Seafood | Coffeehouses Desserts, German, Steak |
| CK | 0.41 | 0.10 | 0.03 | 0.16 | 0.06 | 0.24 | Midtown, Chinatown, TriBeCa | Harlem, Bronx | Indian, Mexican, Chinese, Japanese, Seafood | Vegetarian, Vietnamese, Korean, Hungarian, German |
| OR | 0.24 | 0.06 | 0.16 | 0.41 | 0.10 | 0.03 | W. Village, Chelsea, Chinatown, TriBeCa, E. Village | Upper E. Side, Upper W. Side, Uptown, Bronx, Lower Manhattan | French, Japanese, Portugese, Thai, Middle Eastern | no-dislike |

## Normalizing attribute values

- Must turn real domain values of attributes into cardinal utilities
- Define a component value function for each attribute
  - Highest value mapped to 100, lowest to 0, others to values in interval 0-100
- User independent (cf. weights are user *dependent*)

Mapping of attribute values to utilities in the restaurant domain

| Attribute | Range of values | Mapping of values to cardinal utilities |
|---|---|---|
| Food quality, Service, Decor | 0–30 | value × 3 1/3 |
| Cost | 0–90 | 100 − (10/9 × value) |
| Food type, neighborhood | e.g. Italian, French, West Village | Top values listed by user are mapped to 90, bottom ones to 10 and all others to 50 |



## Computing value of options

- Utility of option, $h$, for particular user

$$U_h = \sum_{i=1}^{K} w_i v_i(x_i)$$

$(x_1, \ldots, x_K)$ *vector of attribute values for an entity h,*
$w_i$ *= weight of attr i,*
$v_i$ *= component value function for attr i*

(Assumes attributes are independent of one another)

- Order options according to predicted utility for that user model

## Restaurant rankings: Japanese restaurant in East Village

- Utilities computed from values and attribute weightings

| User | Restaurant | $U_h$ | FQ(wtd) | SVC(wtd) | DEC(wtd) | Cost(wtd) | Nbhd(wtd) | FT(wtd) |
|---|---|---|---|---|---|---|---|---|
| BA | Komodo | 77 | 22(7) | 22(10) | 19(4) | 29(18) | 90(2) | 90(36) |
| BA | Japonica | 71 | 23(7) | 18(7) | 15(3) | 37(16) | 90(2) | 90(36) |
| BA | Takahachi | 71 | 21(6) | 17(6) | 14(2) | 27(19) | 90(2) | 90(36) |
| BA | Shabu-Tatsu | 70 | 20(5) | 18(7) | 15(3) | 31(17) | 90(2) | 90(36) |
| BA | Bond Street | 69 | 25(8) | 19(8) | 22(4) | 51(11) | 90(2) | 90(36) |
| BA | Dojo | 66 | 15(2) | 12(2) | 8(1) | 14(23) | 90(2) | 90(36) |
| CK | Bond Street | 63 | 25(34) | 19(3) | 22(2) | 51(5) | 50(7) | 50(12) |
| CK | Japonica | 59 | 23(29) | 18(3) | 15(1) | 37(7) | 50(7) | 50(12) |
| CK | Komodo | 59 | 22(26) | 22(4) | 19(2) | 29(8) | 50(7) | 50(12) |
| CK | Takahachi | 54 | 21(24) | 17(2) | 14(1) | 27(8) | 50(7) | 50(12) |
| CK | Shabu-Tatsu | 52 | 20(22) | 18(3) | 15(1) | 31(7) | 50(7) | 50(12) |
| CK | Dojo | 30 | 15(10) | 12(1) | 8(0) | 14(10) | 50(7) | 50(12) |



## Inputs

- SPUR (Speech Planning with Utilities for Restaurants) content planner takes as input:
  - a dialogue strategy goal
  - a user model
  - a conciseness parameter, *z*
  - a set of restaurant options returned by the database that match situational constraints specified in the user's query
- Both option ranking and content selection are sensitive to user model

## Content selection and planning: recommendation

- Given goal and user model, compute ranking of items
- Describe and justify selection of top item
- For each attribute, *z* scores on its weighted values specify deviations from mean score:
  - (a) other attributes for the same option (for recommend), or
  - (b) the same attribute for other options (for compare).
- Select for expression those attributes that are "remarkable enough"
- Use these to justify recommendation

(1) Select the restaurant option $R$ with highest overall utility from returned options.

(2) Using the setting for $z$, identify the attributes $a_i$ whose weighted attribute values $v_i$ for that option are outliers.

(3) Construct a content plan with the claim that $R$ has the best overall value, because $R$ possesses attributes $a_i$ with values $v_i$, as exemplified in Figure 16.



## Content plan: recommendation

content:
1. assert(best(Komodo))
2. assert(has-att(Komodo, cost(29)))
3. assert(has-att(Komodo, foodquality(verygood)))
4. assert(has-att(Komodo, service(verygood)))
5. assert(has-att(Komodo, foodtype(Japanese,Latin American)))



## What is needed to justify a recommendation?

- BA and VM had Komodo at top of ranking, but for different reasons.
- CK had Bond Street at top of ranking
- Setting *z* threshold at 0.3 lets through only those attribute-values that exceed that threshold for that user.

| User | Z value | Output |
|---|---|---|
| CK | 0.3 | Bond Street has the best overall value among the selected restaurants. Bond Street has excellent food quality. |
| BA | 0.3 | Komodo has the best overall value among the selected restaurants. Komodo's price is $29. It's a Japanese, Latin American restaurant. |
| VM | 0.3 | Komodo has the best overall value among the selected restaurants. Komodo's price is $29 and it has very good food quality. |



## Conciseness varies as z threshold varies

- Outliers wrt attribute-values for this option
- Note order in which extra attribute-values are added.

| User | Z-value | Output |
|---|---|---|
| BA | 1.5 | Komodo has the best overall value among the selected restaurants. Komodo's a Japanese, Latin American restaurant. |
| BA | 0.7 | Komodo has the best overall value among the selected restaurants. Komodo's a Japanese, Latin American restaurant. |
| BA | 0.3 | Komodo has the best overall value among the selected restaurants. Komodo's price is $29. It's a Japanese, Latin American restaurant. |
| BA | -0.5 | Komodo has the best overall value among the selected restaurants. Komodo's price is $29 and it has very good service. It's a Japanese, Latin American restaurant. |
| BA | -0.7 | Komodo has the best overall value among the selected restaurants. Komodo's price is $29 and it has very good service and very good food quality. It's a Japanese, Latin American restaurant. |
| BA | -1.5 | Komodo has the best overall value among the selected restaurants. Komodo's price is $29 and it has very good service, very good food quality and good decor. It's a Japanese, Latin American restaurant. |

## Restaurant rankings: Japanese example

- Utilities computed from values and attribute weightings

| User | Restaurant | $U_h$ | FQ(wtd) | SVC(wtd) | DEC(wtd) | Cost(wtd) | Nbhd(wtd) | FT(wtd) |
|---|---|---|---|---|---|---|---|---|
| BA | Komodo | 77 | 22(7) | 22(10) | 19(4) | 29(18) | 90(2) | 90(36) |
| BA | Japonica | 71 | 23(7) | 18(7) | 15(3) | 37(16) | 90(2) | 90(36) |
| BA | Takahachi | 71 | 21(6) | 17(6) | 14(2) | 27(19) | 90(2) | 90(36) |
| BA | Shabu-Tatsu | 70 | 20(5) | 18(7) | 15(3) | 31(17) | 90(2) | 90(36) |
| BA | Bond Street | 69 | 25(8) | 19(8) | 22(4) | 51(11) | 90(2) | 90(36) |
| BA | Dojo | 66 | 15(2) | 12(2) | 8(1) | 14(23) | 90(2) | 90(36) |
| CK | Bond Street | 63 | 25(34) | 19(3) | 22(2) | 51(5) | 50(7) | 50(12) |
| CK | Japonica | 59 | 23(29) | 18(3) | 15(1) | 37(7) | 50(7) | 50(12) |
| CK | Komodo | 59 | 22(26) | 22(4) | 19(2) | 29(8) | 50(7) | 50(12) |
| CK | Takahachi | 54 | 21(24) | 17(2) | 14(1) | 27(8) | 50(7) | 50(12) |
| CK | Shabu-Tatsu | 52 | 20(22) | 18(3) | 15(1) | 31(7) | 50(7) | 50(12) |
| CK | Dojo | 30 | 15(10) | 12(1) | 8(0) | 14(10) | 50(7) | 50(12) |



## Conciseness varies as z threshold varies

- Outliers wrt attribute-values for this option
- Note order in which extra attribute-values are added.

| User | Z-value | Output |
|---|---|---|
| BA | 1.5 | Komodo has the best overall value among the selected restaurants. Komodo's a Japanese, Latin American restaurant. |
| BA | 0.7 | Komodo has the best overall value among the selected restaurants. Komodo's a Japanese, Latin American restaurant. |
| BA | 0.3 | Komodo has the best overall value among the selected restaurants. Komodo's price is $29. It's a Japanese, Latin American restaurant. |
| BA | -0.5 | Komodo has the best overall value among the selected restaurants. Komodo's price is $29 and it has very good service. It's a Japanese, Latin American restaurant. |
| BA | -0.7 | Komodo has the best overall value among the selected restaurants. Komodo's price is $29 and it has very good service and very good food quality. It's a Japanese, Latin American restaurant. |
| BA | -1.5 | Komodo has the best overall value among the selected restaurants. Komodo's price is $29 and it has very good service, very good food quality and good decor. It's a Japanese, Latin American restaurant. |



## Comparisons - option selection

(1) If the number of restaurants is greater than 5 then

(1a) Select the restaurant options $R_i$ that are positive outliers for overall utility (outstanding restaurants). Add a claim $C_j$ to the content plan that the elements of the set $R_i$ have outstanding value.

(1b) If there are no outstanding restaurants, select the 5 highest ranked restaurant options $R_i$ for overall utility $U_h$. Add a claim $C_j$ to the content plan that the elements of the set $R_i$ are the top 5 in overall value.



## Comparisons - content selection

- Note that outliers are now wrt values on attributes across set of options

(1) For each option $R_i$, for each attribute $a_i$

(1a) If the weighted attribute value $v_i$ is an outlier when compared against the weighted attribute value for other options, then add attribute to $OUTLIER-LIST.

(2) For each option $R_i$, for each attribute $a_i$ in $OUTLIER-LIST, add an assertion $s_i$ to the content plan that $R_i$ has the attribute value $v_i$, and a relation that $s_i$ *elaborates* the claim $C_j$.

(3) For each assertion $s_i$ about an attribute $a_i$, add a *contrast* relation to the content plan with the $s_i$ as joint nuclei.

## Content selection and parallelism

- Different numbers of options meet z threshold for different users

| User | Z value | Output |
|---|---|---|
| CK | 0.3 | Among the selected restaurants, the following offer exceptional overall value. Bond Street's price is $51. It has excellent food quality, good service and very good decor. It's a Japanese, Sushi restaurant. Japonica's price is $37. It has excellent food quality, good service and decent decor. It's a Japanese, Sushi restaurant. Komodo's price is $29. It has very good food quality, very good service and good decor. It's a Japanese, Latin American restaurant. |
| VM | 0.3 | Among the selected restaurants, the following offer exceptional overall value. Komodo's price is $29. It has very good food quality, very good service and good decor. Takahachi's price is $27. It has very good food quality, good service and decent decor. |
| BA | 0.3 | Among the selected restaurants, the following offer exceptional overall value. Komodo has very good service, very good food quality and good decor. |



## If an option is described, it is described using all "in-play" attributes

| User | Z-value | Output |
|---|---|---|
| VM | 1.5 | Among the selected restaurants, the following offer exceptional overall value. Komodo has very good service. |
| VM | 0.7 | Among the selected restaurants, the following offer exceptional overall value. Komodo has very good service and good decor. |
| VM | 0.3 | Among the selected restaurants, the following offer exceptional overall value. Komodo's price is $29. It has very good food quality, very good service and good decor. Takahachi's price is $27. It has very good food quality, good service and decent decor. |
| VM | -0.5 | Among the selected restaurants, the following offer exceptional overall value. Komodo's price is $29. It has very good food quality, very good service and good decor. Takahachi's price is $27. It has very good food quality, good service and decent decor. Japonica's price is$37. It has excellent food quality, good service and decent decor |
| VM | -0.7 | Among the selected restaurants, the following offer exceptional overall value. Komodo's price is $29. It has very good food quality, very good service and good decor. Takahachi's price is $27. It has very good food quality, good service and decent decor. Japonica's price is $37. It has excellent food quality, good service and decent decor. Shabu-Tatsu's price is $31. It has very good food quality, good service and decent decor. |
| VM | -1.5 | Among the selected restaurants, the following offer exceptional overall value. Komodo's price is $29. It has very good food quality, very good service and good decor. Takahachi's price is $27. It has very good food quality, good service and decent decor. Japonica's price is $37. It has excellent food quality, good service and decent decor. Shabu-Tatsu's price is $31. It has very good food quality, good service and decent decor. Bond Street's price is $51. It has excellent food quality, good service and very good decor. Dojo's price is $14. It has decent food quality, mediocre service and mediocre decor. |



## From content to a text plan: recommendation

- Recommendation is easy:
  - Each attribute-value helps justify selection:
    - Nucleus plus multiple satellites

| | |
|---|---|
| strategy: | recommend |
| items: | Komodo, Japonica, Takahachi, Shabu-Tatsu, Bond Street, Dojo |
| relations: | justify(nuc:1;sat:2); justify(nuc:1;sat:3); justify(nuc:1,sat:4); justify(nuc:1,sat:5) |
| content: | 1. assert(best(Komodo)) |
| | 2. assert(has-att(Komodo, cost(29))) |
| | 3. assert(has-att(Komodo, foodquality(verygood))) |
| | 4. assert(has-att(Komodo, service(verygood))) |
| | 5. assert(has-att(Komodo, foodtype(Japanese,Latin American))) |



## From content to a text plan: comparison

- Not quite so simple for comparison
  - Need Contrast (somewhere …)

| | |
|---|---|
| strategy: | compare |
| items: | Komodo, Takahachi, Japonica, Shabu-Tatsu, Bond Street, Dojo |
| relations: | elaboration(nuc:1, sat:2); elaboration(nuc:1, sat:3); elaboration(nuc:1, sat:4); elaboration(nuc:1, sat:5); elaboration(nuc:1, sat:6); elaboration(nuc:1, sat:7); elaboration(nuc:1, sat:9); elaboration(nuc:1, sat:9); contrast(nuc:2, nuc:3); contrast(nuc:4, nuc:5); contrast(nuc:6, nuc:7); contrast(nuc:8, nuc:9) |
| content: | 1. assert(exceptional(Komodo's, Takahachi's)) |
| | 2. assert(has-att(Komodo, cost(29))) |
| | 3. assert(has-att(Takahachi's, cost(27))) |
| | 4. assert(has-att(Komodo, service(verygood))) |
| | 5. assert(has-att(Takahachi's, service(good))) |
| | 6. assert(has-att(Komodo, decor(good))) |
| | 7. assert(has-att(Takahachi's, decor(decent))) |
| | 8. assert(has-att(Komodo, foodquality(verygood))) |
| | 9. assert(has-att(Takahachi's, foodquality(good))) |

## Some text plans work for limited amounts of data only ...

| Z | Output |
|---|---|
| 1.5 | Among the selected restaurants, the following offer exceptional overall value. Komodo has very good service. |
| 0.7 | Among the selected restaurants, the following offer exceptional overall value. Komodo has very good service and good decor. |
| 0.3 | Among the selected restaurants, the following offer exceptional overall value. Komodo's price is \$29. It has very good food quality, very good service and good decor. Takahachi's price is \$27. It has very good food quality, good service and decent decor. |
| -0.5 | Among the selected restaurants, the following offer exceptional overall value. Komodo's price is \$29. It has very good food quality, very good service and good decor. Takahachi's price is \$27. It has very good food quality, good service and decent decor. Japonica's price is\$37. It has excellent food quality, good service and decent decor |
| -0.7 | Among the selected restaurants, the following offer exceptional overall value. Komodo's price is \$29. It has very good food quality, very good service and good decor. Takahachi's price is \$27. It has very good food quality, good service and decent decor. Japonica's price is \$37. It has excellent food quality, good service and decent decor. Shabu-Tatsu's price is \$31. It has very good food quality, good service and decent decor. |
| -1.5 | Among the selected restaurants, the following offer exceptional overall value. Komodo's price is \$29. It has very good food quality, very good service and good decor. Takahachi's price is \$27. It has very good food quality, good service and decent decor. Japonica's price is \$37. It has excellent food quality, good service and decent decor. Shabu-Tatsu's price is \$31. It has very good food quality, good service and decent decor. Bond Street's price is \$51. It has excellent food quality, good service and very good decor. Dojo's price is \$14. It has decent food quality, mediocre service and mediocre decor. |



## So, what are the text structural options?

| | |
|---|---|
| strategy: | compare3 |
| items: | Above, Carmine's |
| relations: | elaboration(nuc:1,sat:2); elaboration(nuc:1,sat:3); elaboration(nuc:1,sat:4); elaboration(nuc:1,sat:5); elaboration(nuc:1,sat:6); elaboration(nuc:1,sat:7); contrast(nuc:2,nuc:3); contrast(nuc:4,nuc:5); contrast(nuc:6,nuc:7) |
| content: | 1. assert(exceptional(Above,Carmine's))<br>2. assert(has-att(Above, decor(good)))<br>3. assert(has-att(Carmine's, decor(decent)))<br>4. assert(has-att(Above, service(good)))<br>5. assert(has-att(Carmine's, service(good)))<br>6. assert(has-att(Above, cuisine(New American)))<br>7. assert(has-att(Carmine's, cuisine(Italian))) |



## Some text plans are seemingly better than others ...

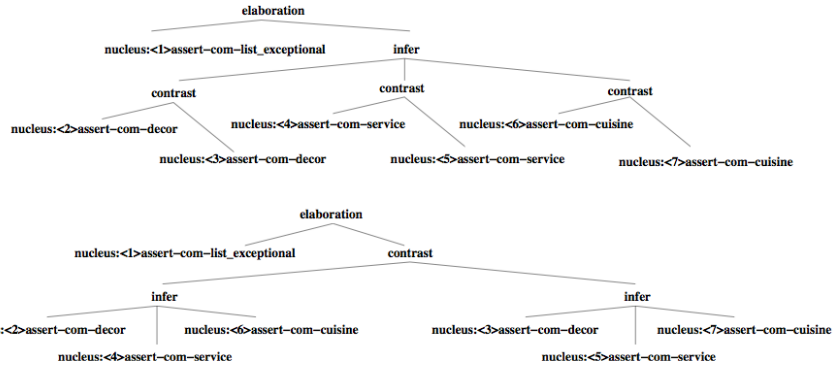
| Alt | Realization | A | B | AVG |
|---|---|---|---|---|
| 11 | Above and Carmine's offer exceptional value among the selected restaurants. Above, which is a New American restaurant, with good decor, has good service. Carmine's, which is an Italian restaurant, with good service, has decent decor. | 2 | 2 | 2 |
| 12 | Above and Carmine's offer exceptional value among the selected restaurants. Above has good decor, and Carmine's has decent decor. Above and Carmine's have good service. Above is a New American restaurant. On the other hand, Carmine's is an Italian restaurant. | 3 | 2 | 2.5 |
| 13 | Above and Carmine's offer exceptional value among the selected restaurants. Above is a New American restaurant. It has good decor. It has good service. Carmine's, which is an Italian restaurant, has decent decor and good service. | 3 | 3 | 3 |
| 14 | Above and Carmine's offer exceptional value among the selected restaurants. Above has good decor while Carmine's has decent decor, and Above and Carmine's have good service. Above is a New American restaurant while Carmine's is an Italian restaurant. | 4 | 5 | 4.5 |
| 20 | Above and Carmine's offer exceptional value among the selected restaurants. Carmine's has decent decor but Above has good decor, and Carmine's and Above have good service. Carmine's is an Italian restaurant. Above, however, is a New American restaurant. | 2 | 3 | 2.5 |
| 25 | Above and Carmine's offer exceptional value among the selected restaurants. Above has good decor. Carmine's is an Italian restaurant. Above has good service. Carmine's has decent decor. Above is a New American restaurant. Carmine's has good service. | NR | NR | NR |

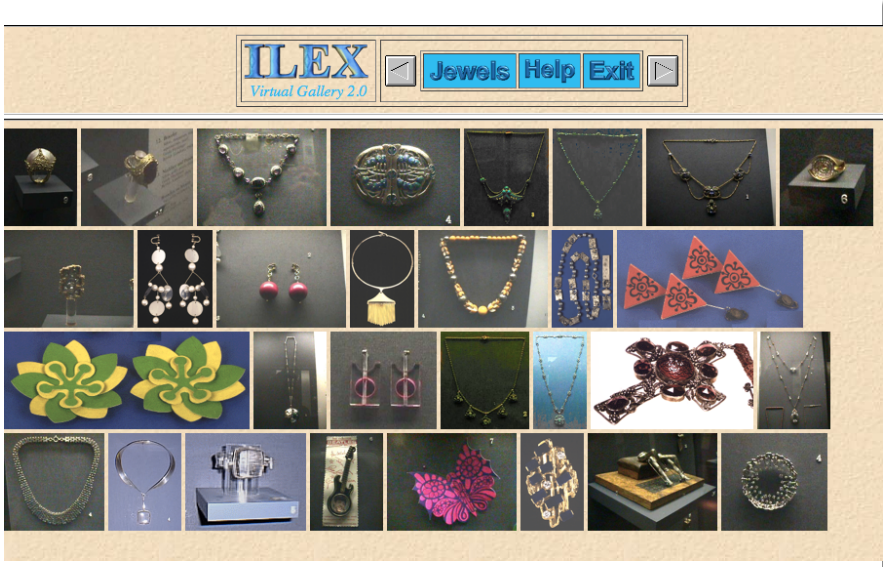
Human ratings: 1 = worst, 5 = best



## Does a single content selection get a single text plan?

- Not necessarily - even when we select stronger relations.
- But how do we choose? (cf. lectures on statistical NLG)








## ILEX: a generated page




## ILEX: a generated page (close-up)

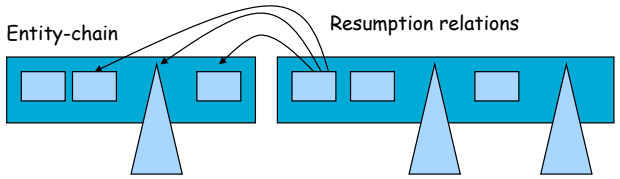
This jewel is a brooch and was made by Martin Page. It is also in the Organic style. It was made in 1979. Although Organic style jewels usually have a coarse texture this jewel has smooth surfaces.

Organic style jewels usually draw on natural themes for inspiration; for instance the previous item uses natural pearls. Organic style jewels are usually encrusted with gems; for instance the previous item has silver links encrusted asymetrically with pearls and diamonds.

Other jewels in the style include:

- a Bjorn Weckstrom pendant-necklace
- the previous item
- a Frances Beck finger ring
- a Jacqueline Mina finger ring
- a Kutchinsky finger ring
- an Ernest Blyth finger ring
- a Gilian Packard finger ring
- a John Donald brooch

## ILEX: possible and preferred discourse structures




- ILEX uses a bottom-up text structuring with rhetorical relations, but does not require whole discourse to be connected via RR (compare Marcu 1997.)
- On top of the rhetorical/focussing model, we propose a set of evaluation heuristics to rank possible text structures:
  - Avoid entity chains that are very short
  - Prefer a resumption which is close to the fact which introduces it over one which is distant.
  - Prefer entity-chains whose order of appearance is the same as the order of the facts which introduced them.
  - Disprefer two entity-chains with the same focus.



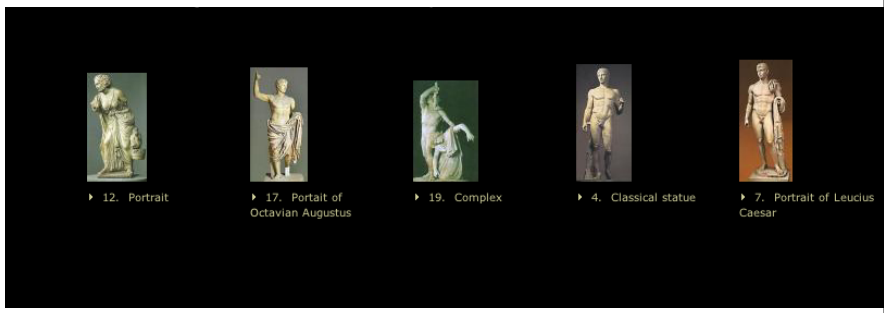
## ILEX: a generated example

- (1) This piece is a necklace. (2) It was designed by a jeweller called Jessie King. (3) It was designed in 1905. (4) It is made of silver and enamel.
- (5) Jessie King was a famous designer. (6) She was Scottish, (7) but she worked in London. (8) It was in London that this piece was made.
- (9) Like the previous piece, (10) this piece is in the Arts-and-Crafts style. (11) Although the previous piece had a simple shape, (12) Arts-and-Crafts style jewels tend to be elaborate; (13) for instance, this piece has detailed florals.

- Note the resumption from (5-8) back to (1-4)

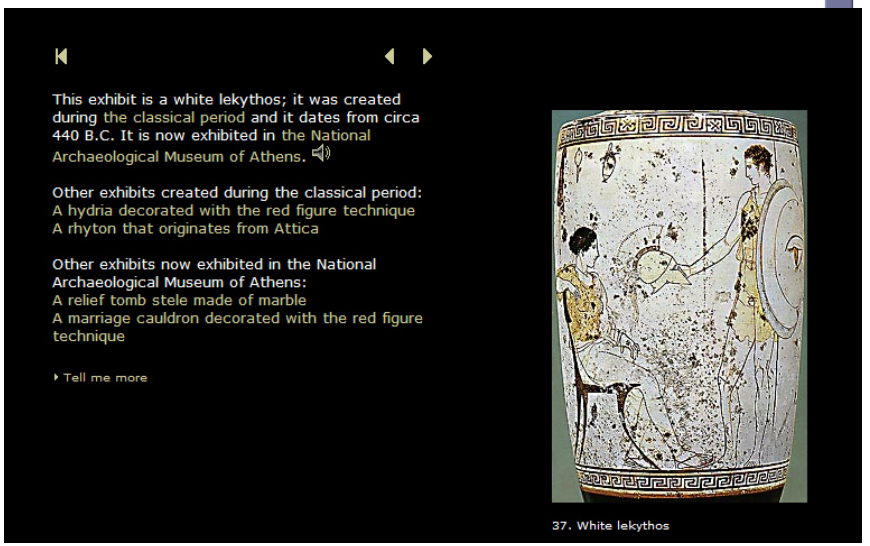


## (Sidenote) M-PIRO: a front page






## (Sidenote) NLG: we speak your language



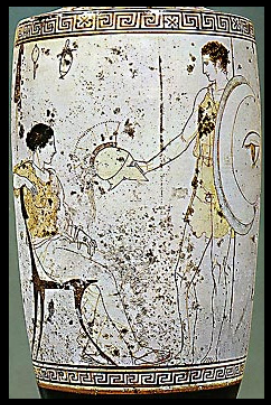
## (Sidenote) NLG: we speak your language

Questo reperto è una lekythos bianca, creata durante il periodo classico. Risale al 440 a.C. circa. Fu dipinta dal pittore d'Achille ed oggi è conservata al Museo Archeologico Nazionale di Atene.

Altri oggetti che furono creati durante il periodo classico:
Una kylix che proviene dall'Attica
Uno stamnos che è fatto in argilla

Altri oggetti che sono conservati al Museo Archeologico Nazionale di Atene:
Una lekythos che proviene dall'Attica
Un cratere da nozze che fu creato durante il periodo classico

Dimmi di più



37. Lekythos bianca

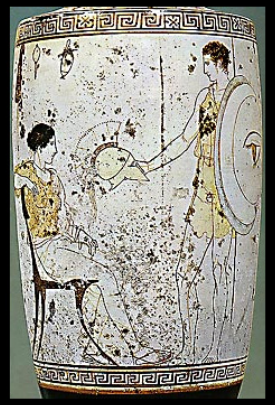
## (Sidenote) NLG: we speak your language

Αυτό το έκθεμα είναι μια λευκή λήκυθος, που δημιουργήθηκε κατά τη διάρκεια της κλασικής περιόδου. Χρονολογείται περίπου στο 440 π.Χ. Σήμερα βρίσκεται στο Εθνικό Αρχαιολογικό Μουσείο της Αθήνας.

Άλλα εκθέματα που δημιουργήθηκαν κατά τη διάρκεια της κλασικής περιόδου:
Μια λήκυθος που προέρχεται από την Αττική
Ένας γαμικός λέβης που προέρχεται από την Αττική

Άλλα εκθέματα που βρίσκονται στο Εθνικό Αρχαιολογικό Μουσείο της Αθήνας:
Μια ανάγλυφη επιτύμβια στήλη που δημιουργήθηκε κατά τη διάρκεια της ρωμαϊκής περιόδου
Μια λήκυθος που ανήκει στον ερυθρόμορφο ρυθμό

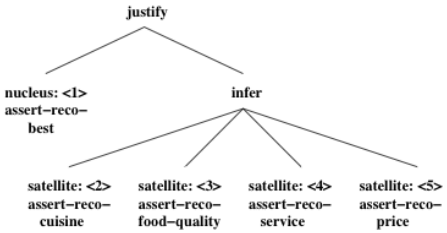
Πες μου περισσότερα!



37. Λευκή λήκυθος

## Final point: Does a single text plan get a single sentence plan?

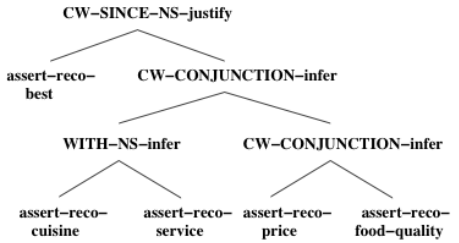
- Anticipating lectures on sentence planning …





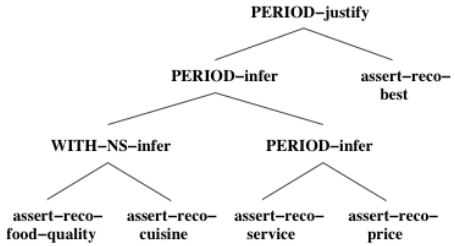

## Single text plan, multiple sentence plans

- Who says the core claim comes first?



## Single text plan, multiple sentence plans

- Who says the core claim comes first?






## Another dimension of variation ...

relations: justify(nuc:1, sat:2); justify (nuc:1, sat:3 ); justify(nuc:1, sat:4); justify(nuc:1, sat:5)
content:
1. assert(best (Chanpen Thai))
2. assert(is (Chanpen Tai, cuisine(Thai)))
3. assert(has-att(Chanpen Thai, food-quality(good)))
4. assert(has-att(Chanpen Thai, service(good)))
5. assert(is (Chanpen Thai, price(24 dollars)))



## Another dimension of variation ... back to the user!

| Alt | Realization | A | B | AVG |
|---|---|---|---|---|
| 6 | Chanpen Thai has the best overall quality among the selected restaurants since it is a Thai restaurant, with good service, its price is 24 dollars, and it has good food quality. | 1 | 4 | 2.5 |
| 7 | Chanpen Thai has the best overall quality among the selected restaurants because it has good service, it has good food quality, it is a Thai restaurant, and its price is 24 dollars. | 2 | 5 | 3.5 |
| 4 | Chanpen Thai has the best overall quality among the selected restaurants. It has good food quality, with good service, it is a Thai restaurant, and its price is 24 dollars. | 2 | 4 | 3 |
| 9 | Chanpen Thai is a Thai restaurant, with good food quality, its price is 24 dollars, and it has good service. It has the best overall quality among the selected restaurants. | 2 | 4 | 3 |
| 5 | Chanpen Thai has the best overall quality among the selected restaurants. It has good service. It has good food quality. Its price is 24 dollars, and it is a Thai restaurant. | 3 | 2 | 2.5 |
| 3 | Chanpen Thai has the best overall quality among the selected restaurants. Its price is 24 dollars. It is a Thai restaurant, with good service. It has good food quality. | 3 | 3 | 3 |
| 10 | Chanpen Thai has the best overall quality among the selected restaurants. It has good food quality. Its price is 24 dollars. It is a Thai restaurant, with good service. | 3 | 3 | 3 |
| 2 | Chanpen Thai has the best overall quality among the selected restaurants. Its price is 24 dollars, and it is a Thai restaurant. It has good food quality and good service. | 4 | 4 | 4 |
| 1 | Chanpen Thai has the best overall quality among the selected restaurants. This Thai restaurant has good food quality. Its price is 24 dollars, and it has good service. | 4 | 3 | 3.5 |
| 8 | Chanpen Thai is a Thai restaurant, with good food quality. It has good service. Its price is 24 dollars. It has the best overall quality among the selected restaurants. | 4 | 2 | 3 |



## Summary

- Content planning takes goals and user models, and selects and organises content.
- Selection and structuring can be top-down or bottom-up:
  - Goal directly drives structure; or structure emerges from possible connections among content.
- Even when content is fixed, multiple text structures are possible.
  - Not all relations need be expressed.
- Even when subset of relations is chosen, some text structures are 'better' than others
  - And sometimes the difference is (only) in the eye of user
- Even when text plan is chosen, multiple sentence plans are possible.
- Variation is the spice of NLG.

## From content to a text plan: recommendation

- Recommendation is easy:
  - Each attribute-value helps justify selection:
    - Nucleus plus multiple satellites

| | |
|---|---|
| strategy: | recommend |
| items: | Komodo, Japonica, Takahachi, Shabu-Tatsu, Bond Street, Dojo |
| relations: | justify(nuc:1;sat:2); justify(nuc:1;sat:3); justify(nuc:1,sat:4); justify(nuc:1,sat:5) |
| content: | 1. assert(best(Komodo)) |
| | 2. assert(has-att(Komodo, cost(29))) |
| | 3. assert(has-att(Komodo, foodquality(verygood))) |
| | 4. assert(has-att(Komodo, service(verygood))) |
| | 5. assert(has-att(Komodo, foodtype(Japanese,Latin American))) |